

Bulletin of the University of New Hampshire

Call
378.742
N5345
1967/68

THE LIBRARY

Three Copies



University of New Hampshire

Library

UNIVERSITY of NEW HAMPSHIRE

The Graduate School

1967-1968

VOLUME LVIII, NUMBER 7, FEBRUARY 1967. The Bulletin of the University of New Hampshire is published twice in November and February and once each in September, December, January, and May. Second class postage paid at Durham, New Hampshire 03824.

Contents

University Calendar

4

Officers and Faculty of the Graduate School

Trustees	8	Faculty	9
Administrative Officers	9	Committees	16

Regulations of the Graduate School

Graduate Degree Programs	18	Requirements for	
General Information	19	the Master's Degree	24
General Regulations	19	Requirements for	
Assistantships, Scholarships		the Doctor's Degree	26
and Fellowships	22	University Services	28

Departmental Requirements and Description of Courses

IBM Key Codes	32	German and Russian	93
Agricultural Education	33	History	96
Animal Sciences	35	Home Economics	100
Biochemistry	37	Language, General	103
Biology	39	Mathematics	103
Botany	40	Mechanical Engineering	110
Business Administration	42	Microbiology	114
Chemical Engineering	46	Music	116
Chemistry	49	Physics	120
Civil Engineering	55	Plant Science	124
Economics	59	Political Science	126
Education	62	Psychology	132
Electrical Engineering	74	Resource Economics	139
English	77	Social Science	140
Entomology	81	Sociology	141
Forest Resources	82	Soil and Water Science	144
French and Italian	84	Spanish and Classics	146
Genetics Program	87	Technology	149
Geology	91	Zoology	149

University Calendar

Summer Session 1967

June 26, Monday	Registration, eight-week session and first four-week session
June 27, Tuesday	First day of classes
July 10, Monday	Registration, six-week session
July 11, Tuesday	First day of classes
July 24, Monday	Registration and first day of classes, second four-week session
August 18, Friday	Classes end

1967-68

Semester I

July 15, Saturday	Last day for application for admission to graduate study for Semester I
September 15, Friday	First Faculty meeting
September 19, Tuesday	Registration
September 20, Wednesday	Classes begin
November 15, Wednesday	Last day for application for admission to graduate study for Semester II
November 21, Tuesday	Thanksgiving recess begins, 7:00 p.m.
November 27, Monday	Classes resume, 8:00 a.m.
November 27, Monday	Last day for filing applications for graduate scholarships for second semester
December 15, Friday	Christmas recess begins, 7:00 p.m.
January 2, Tuesday	Classes resume, 8:00 a.m.
January 22, Monday	Examinations begin
January 31, Wednesday	Examinations end

Semester II

February 8, Thursday	Registration
February 9, Friday	Classes begin
February 9, Friday	Last day for filing applications for graduate scholarships for academic year 1968-69
February 10, Saturday	Classes hold Tuesday schedule
March 22, Friday	Spring recess begins
April 1, Monday	Classes resume
April 1, Monday	Last day for filing application for 1968 Summer Session graduate scholarships
May 10, Friday	Last day for presenting Ph.D. dissertation at Graduate School Office, if degree is to be granted in June
May 24, Friday	Last day for presenting completed Master's thesis to Graduate School Office, if degree is to be granted in June
May 24, Friday	Last day for final Ph.D. oral examinations, if degree is to be granted in June
May 27, Monday	Final Examinations begin, 8:00 a.m.
June 6, Thursday	Final Examinations end, 6:00 p.m.
June 9, Sunday	Commencement

Officers and Faculty of the Graduate School

Trustees

His Excellency, JOHN W. KING, A.B., M.A., LL.B., LL.D., *ex officio*
Governor of New Hampshire

FRANK T. BUCKLEY, *ex officio*
Commissioner of Agriculture

PAUL E. FARNUM, B.S., M.S., *ex officio*
Commissioner of Education

JOHN W. McCONNELL, B.A., PH.D., D.Sc., *ex officio*
President of the University

HAROLD E. HYDE, B.S., M.S., ED.D., *ex officio*
President of Plymouth State College

ROMAN J. ZORN, B.ED., PH.D., *ex officio*
President of Keene State College

DEAN P. WILLIAMSON, B.S., Concord (1960-1968)
Chairman of the Board

FRED W. HALL, JR., B.S., LL.B., Rochester (1966-1969)
Vice Chairman of the Board

NORMAN S. WEEKS, B.S., Laconia (1965-1969)
Secretary of the Board

FRANK W. RANDALL, B.S., LL.D., Portsmouth (1936-1968)

MAURICE F. DEVINE, A.B., LL.B., LL.D., Manchester (1949-1970)

FORREST M. EATON, B.S., Portsmouth (1959-1967)

J. FRED FRENCH, Manchester (1961-1968)

SINCLAIR WEEKS, A.B., LL.D., Lancaster (1961-1969)

ALBERT R. FURLONG, B.E., M.E., Keene (1963-1967)

DOUGLAS L. ROBERTSON, B.ED., M.ED., Plymouth (1963-1967)

NORMAN C. BERUBE, B.A., M.D., Manchester (1963-1967)

RICHARD BLALOCK, Portsmouth (1963-1967)

GEORGE R. HANNA, B.A., LL.B., Keene, (1963-1967)

MILDRED McAFFEE HORTON, B.A., M.A., Randolph (1963-1967)

EUGENE C. STRUCKHOFF, A.B., LL.B., Concord (1963-1967)

BERNARD I. SNIERSON, A.B., LL.B., Laconia (1963-1967)

RICHARD W. DALAND, B.S., Durham (1966-1970)

RAY HOWLAND, JR., Stratham (1966-1970)

Administrative Officers

JOHN W. McCONNELL, PH.D., *President of the University*

JERE A. CHASE, M.ED., *Executive Vice President*

NORMAN W. MYERS, B.S., *Vice President-Treasurer*

ROBERT F. BARLOW, PH.D., *Academic Vice President, Dean of the Whittemore School and Professor of Economics*

EUGENE S. MILLS, M.A., PH.D., *Dean of the Graduate School and Professor of Psychology*

WILLIAM H. DREW, M.S., PH.D., *Associate Dean of the Graduate School and Professor of Resource Economics*

HARRY A. KEENER, M.S., PH.D., *Dean of the College of Agriculture and Professor of Dairy Science*

EVERETT B. SACKETT, M.A., PH.D., *Dean of the College of Liberal Arts and Professor of Education*

ROBERT N. FAIMAN, M.S., PH.D., *Dean of the College of Technology and Professor of Electrical Engineering*

EDWARD J. DURNALL, M.A., ED.M., ED.D., *Director of University Extension, Director of the Summer Session, and Associate Professor of Education*

DONALD E. VINCENT, A.M.L.S., A.M., *Librarian*

OWEN B. DURGIN, M.A., *Registrar*

Faculty

FRED E. ALLEN, D.V.M., *Professor of Animal Science*

E. EUGENE ALLMENDINGER, M.S., *Associate Professor of Mechanical Engineering*

ALEXANDER R. AMELL, PH.D., *Professor of Chemistry*

KENNETH K. ANDERSEN, PH.D., *Associate Professor of Chemistry*

MICHAEL D. ANDREW, A.M.T., *Assistant Professor of Education*

RICHARD A. ANDREWS, M.S., PH.D., *Associate Professor of Resource Economics*

WILLIAM H. ANNIS, M.A.G.ED., ED.D., *Associate Professor of Agricultural Education*

KARL SIEGFRIED NORMAN ARNDT, M.A., PH.D., *Assistant Professor of German*

GILBERT R. AUSTIN, M.A., PH.D., *Assistant Professor of Education*

VICTOR D. AZZI, PH.D., *Associate Professor of Mechanical Engineering*

ROBERT F. BARLOW, M.A., PH.D., *Professor of Economics*

JAMES P. BARRETT, M.F., PH.D., *Associate Professor of Forest Resources*

GERALD M. BATCHELDER, M.S., *Research Associate Professor, Engineering Experiment Station*

EDWARD H. BATHO, M.S., PH.D., *Professor of Mathematics*

WAYNE M. BEASLEY, S.M., *Adjunct Associate Professor of Materials Science*

-
- HOMER F. BECHTELL, PH.D., *Associate Professor of Mathematics*
JOHN A. BECKETT, M.B.A., C.P.A., *Forbes Professor of Management*
JERE R. BECKMAN, M.S., D.V.M., *Assistant Professor of Animal Science*
CHARLES V. BERNEY, PH.D., *Assistant Professor of Chemistry*
SYLVESTER H. BINGHAM, M.A., PH.D., *Professor of English*
FLETCHER A. BLANCHARD, M.S., *Associate Professor of Electrical Engineering*
ROBERT L. BLICKLE, M.S., PH.D., *Professor of Entomology*
MELVIN T. BOBICK, M.A., PH.D., *Associate Professor of Sociology*
WILLIAM E. BONNICE, PH.D., *Associate Professor of Mathematics*
ARTHUR C. BORROR, M.S., PH.D., *Associate Professor of Zoology*
JAMES R. BOWRING, M.S., PH.D., *Professor of Resource Economics*
ANGELO V. BOY, ED.M., ED.D., *Associate Professor of Education*
C. HILTON BOYNTON, M.S., PH.D., *Professor of Dairy Science*
JASON E. BOYNTON, M.ED., *Assistant Professor of Education*
ALLAN J. BRAFF, M.B.A., PH.D., *Associate Professor of Economics and Business*
KARL H. BRATTON, M.A., *Professor of Music*
JOSEPH D. BRONZINO, M.S., *Assistant Professor of Electrical Engineering*
PAUL E. BRUNS, M.F., PH.D., *Professor of Forest Resources*
WILBUR L. BULLOCK, M.S., PH.D., *Professor of Zoology*
DAVID M. BURTON, M.A., PH.D., *Associate Professor of Mathematics*
GORDON L. BYERS, M.S., *Professor of Soil and Water Science*
LAURENCE J. CAHILL, JR., M.S., PH.D., *Professor of Physics*
R. ALBERTO CASAS, A.M., PH.D., *Professor of Spanish*
WILLIAM R. CHESBRO, M.S., PH.D., *Associate Professor of Microbiology*
DAVID H. CHITTENDEN, M.S., PH.D., *Assistant Professor of Chemical
Engineering*
SOON CHOUGH, A.B., *Assistant Professor of Economics*
ROBERT L. CHRISTENSEN, M.S., *Assistant Professor of Resource Economics*
EDWARD L. CHUPP, A.B., PH.D., *Associate Professor of Physics*
DAVID G. CLARK, M.S., PH.D., *Associate Professor of Physics*
RONALD R. CLARK, M.ENG., PH.D., *Associate Professor of Electrical
Engineering*
ALLAN R. COHEN, A.B., M.B.A., *Visiting Assistant Professor of Business
Administration*
LAWRENCE P. COLE, M.S., *Assistant Professor of Economics*
WALTER M. COLLINS, M.S., PH.D., *Professor of Poultry Science*
NICHOLAS F. COLOVOS, M.S., *Professor of Animal Science*
JAMES G. CONKLIN, M.S., *Professor of Entomology*
CARL J. COOPER, ED.M., PH.D., *Assistant Professor of Education*
ALAN C. CORBETT, M.S., D.V.M., *Associate Professor of Poultry Science*
ROBERT W. CORELL, M.S., PH.D., *Professor of Mechanical Engineering*
ROBERT A CROKER, M.S., PH.D., *Professor of Zoology*
ALBERT F. DAGGETT, M.S., PH.D., *Professor of Chemistry*
G. HARRIS DAGGETT, M.A., PH.D., *Professor of English*
-

-
- CHARLES O. DAWSON, M.S., *Professor of Civil Engineering*
CARROLL M. DEGLER, A.B., M.B.A., *Professor of Business and Economics*
ROBERT B. DISHMAN, A.M., PH.D., *Professor of Political Science*
PETER DODGE, M.A., PH.D., *Associate Professor of Sociology*
EDWARD T. DONOVAN, B.S., *Professor of Mechanical Engineering*
JOHN DOWLING, JR., M.S., PH.D., *Assistant Professor of Physics*
RICHARD E. DOWNS, PH.D., *Associate Professor of Sociology*
DAVID D. DRAVES, M.A., PH.D., *Associate Professor of Education*
WILLIAM H. DREW, M.S., PH.D., *Professor of Resource Economics*
WILLIAM R. DUNLOP, D.V.M., V.S., *Professor of Poultry Science*
GERALD M. DUNN, M.S., PH.D., *Professor of Plant Science*
STUART DUNN, M.S., PH.D., *Professor of Botany*
WALTER N. DUROST, M.A., PH.D., *Associate Professor of Education*
RUSSELL EGGERT, M.S., *Professor of Plant Science*
DAVID W. ELLIS, PH.D., *Assistant Professor of Chemistry*
RAYMOND L. ERICKSON, PH.D., *Associate Professor of Psychology*
STEPHEN S. T. FAN, M.S., PH.D., *Associate Professor of Chemical Engineering*
BENNETT B. FOSTER, M.F., PH.D., *Assistant Professor of Forest Resources*
ARNOLD FOWLER, M.S., PH.D., *Assistant Professor of Dairy Science*
GEORGE E. FRICK, M.S., *Adjunct Professor of Resource Economics*
ALBERT D. FROST, M.A., SC.D., *Professor of Electrical Engineering*
HERMAN GADON, A.B., PH.D., *Associate Professor of Business Administration*
GLENDON W. GEE, PH.D., *Assistant Professor of Soil and Water Science*
HENRY M. GEHRHARDT, M.S., PH.D., *Assistant Professor of Chemical Engineering*
SOM N. GHEI, M.A., PH.D., *Associate Professor of Psychology*
PAUL A. GILMAN, M.S., *Associate Professor of Agricultural Engineering Technology*
ROBERT C. GILMORE, M.A., PH.D., *Associate Professor of History*
FILSON H. GLANZ, M.S., PH.D., *Assistant Professor of Electrical Engineering*
LEWIS C. GOFFE, M.A., PH.D., *Associate Professor of English*
EARL O. GOODMAN, JR., ED.D., *Associate Professor of Home Economics*
CLARENCE L. GRANT, M.S., PH.D., *Research Professor Engineering Experiment Station and Adjunct Professor of Chemistry*
WILLIAM GREENLEAF, M.A., PH.D., *Professor of History*
MERLE D. GUAY, M.A., *Assistant Professor of Mathematics*
GORDON A. HAALAND, A.B., PH.D., *Assistant Professor of Psychology*
HELMUT M. HAENDLER, PH.D., *Professor of Chemistry*
EARL C. HAGSTROM, PH.D., *Associate Professor of Psychology*
FRANCIS R. HALL, M.A., PH.D., *Associate Professor of Soil and Water Science*
HARRY H. HALL, PH.D., *Professor of Physics*
ROBERT D. HAPGOOD, M.A., PH.D., *Associate Professor of English*
GEORGE M. HASLERUD, PH.D., *Professor of Psychology*
HANS HEILBRONNER, PH.D., *Professor of History*
-

-
- WILLIAM F. HENRY, M.S., *Professor of Resource Economics*
EDWARD J. HERBST, M.S., PH.D., *Professor of Biochemistry*
JOHN L. HILL, M.S., D.F., *Associate Professor of Forest Resources*
FREDERICK G. HOCHGRAF, M.S., *Associate Professor of Materials Science*
HAROLD W. HOCKER, JR., M.F., D.F., *Associate Professor of Forest Resources*
ALBION HODGDON, M.S., PH.D., *Professor of Botany*
JOHN A. HOGAN, M.A., PH.D., *Carter Professor of Economics*
JOHN T. HOLDEN, M.A., PH.D., LL.D., *Professor of Political Science*
JAMES B. HOLTER, M.S., PH.D., *Assistant Professor of Dairy Science*
FRANK K. HOORNBECK, M.S., PH.D., *Assistant Professor of Zoology*
JAMES O. HORRIGAN, M.B.A., *Assistant Professor of Business Administration*
ROGER H. HOU, PH.D., *Assistant Professor of Mathematics*
ROBERT E. HOUSTON, JR., M.S., PH.D., *Professor of Physics*
JOHN B. HRABA, M.ENG., PH.D., *Professor of Electrical Engineering*
LOUIS J. HUDON, M.A., PH.D., *Professor of French*
MIYOSHI IKAWA, M.S., PH.D., *Professor of Biochemistry*
ROSELMINA INDRISANO, M.ED., ED.D., *Assistant Professor of Education*
RICHARD L. INGERSOLL, M.A., PH.D., *Assistant Professor of Sociology*
MANLEY R. IRWIN, M.A., PH.D., *Associate Professor of Economics*
ROBERT M. ISHERWOOD, M.A., PH.D., *Assistant Professor of History*
ROBB JACOBY, S.M., PH.D., *Professor of Mathematics*
ERWIN A. JAFFE, M.A., PH.D., *Associate Professor of Political Science*
MARION E. JAMES, M.A., PH.D., *Associate Professor of History*
CHARLES A. JELLISON, M.A., PH.D., *Associate Professor of History*
FREDERICK M. JERVIS, PH.D., *Associate Professor of Psychology*
RICHARD E. JOHNSON, M.A., PH.D., *Professor of Mathematics*
GALEN JONES, PH.D., *Professor of Microbiology*
PAUL R. JONES, PH.D., *Professor of Chemistry*
WILLIAM R. JONES, M.A., PH.D., *Associate Professor of History*
RICHARD L. KAUFMANN, M.S., PH.D., *Associate Professor of Physics*
TENHO S. KAUPPINEN, M.S., *Associate Professor of Mechanical Engineering*
ROBERT O. KIMBALL, M.A., *Assistant Professor of Mathematics*
ROLAND B. KIMBALL, M.ED., ED.D., *Professor of Education*
MARK P. KLEIN, M.S., PH.D., *Assistant Professor of Physics*
LOUIS H. KLOTZ, M.C.E., *Assistant Professor of Civil Engineering*
WAYNE S. KOCH, M.ED., *Professor of Education*
JOHN J. KORBEL, M.B.A., PH.D., *Associate Professor of Economics and Business*
SHAN S. KUO, M.S., M.E., D.ENG., *Professor of Applied Mathematics*
DWIGHT R. LADD, M.B.A., D.B.A., *Professor of Business Administration*
ROBERT H. LAMBERT, M.S., PH.D., *Associate Professor of Physics*
CLARENCE A. LANGER, M.S., PH.D., *Professor of Plant Science*
HAROLD E. LANGLEY, JR., M.S., SC.D., *Associate Professor of Civil Engineering*
DAVID L. LARSON, M.A., PH.D., *Associate Professor of Political Science*
-

-
- MARCEL E. LAVOIE, M.S., PH.D., *Associate Professor of Zoology*
URSULA D. LAWSON, M.A., PH.D., *Assistant Professor of German*
CHARLES H. LEIGHTON, M.A., PH.D., *Associate Professor of Spanish*
NELSON R. LERAY, M.S., ED.D., *Adjunct Associate Professor of Resource Economics*
- ARNOLD S. LINSKY, M.A., PH.D., *Assistant Professor of Sociology*
JOHN A. LOCKWOOD, M.S., PH.D., *Professor of Physics*
DAVID F. LONG, M.A., PH.D., *Professor of History*
GLORIA G. LYLE, M.S., PH.D., *Associate Professor of Chemistry*
ROBERT E. LYLE, JR., M.S., PH.D., *Professor of Chemistry*
DONALD C. MARSCHNER, PH.D., *Associate Professor of Business Administration*
- GROVER E. MARSHALL, M.A., *Assistant Professor of French and Italian*
THOMAS O. MARSHALL, ED.M., ED.D., *Professor of Education*
ARTHUR MATHIESON, M.A., PH.D., *Assistant Professor of Botany*
MAX S. MAYNARD, B.A., *Associate Professor of English*
LORNE A. MCFADDEN, M.S., PH.D., *Associate Professor of Plant Science*
DONALD W. MELVIN, M.ENG., *Associate Professor of Electrical Engineering*
CARLETON P. MENGE, M.A., PH.D., *Professor of Education*
THEODORE G. METCALF, PH.D., *Professor of Microbiology*
EDMUND G. MILLER, M.A., PH.D., *Associate Professor of English*
GEORGE M. MOORE, M.S., PH.D., *Professor of Zoology*
HERBERT C. MOORE, M.S., *Associate Professor of Dairy Science*
JAMES D. MORRISON, PH.D., *Assistant Professor of Chemistry*
WILLIAM MOSBERG, M.ENG., *Associate Professor of Mechanical Engineering*
LYMAN MOWER, PH.D., *Professor of Physics*
JOHN E. MULHERN, JR., M.A., PH.D., *Professor of Physics*
GEORGE H. MULLEN, M.S., PH.D., *Assistant Professor of Physics*
M. EVANS MUNROE, SC.M., PH.D., *Professor of Mathematics*
JOSEPH B. MURDOCH, M.S., PH.D., *Professor of Electrical Engineering*
DONALD M. MURRAY B.A., *Associate Professor of English*
CHARLOTTE NAST, M.A., PH.D., *Professor of Botany*
PHILIP L. NICOLOFF, M.A., PH.D., *Associate Professor of English*
MELVILLE NIELSON, M.A., PH.D., *Associate Professor of Sociology*
ERIC A. NORDGREN, PH.D., *Assistant Professor of Mathematics*
DOUGLAS M. NORRIS, JR., M.E., PH.D., *Associate Professor of Mechanical Engineering*
- PHILIP E. NORTHWAY, A.M.T., M.A., *Assistant Professor of Education*
ROBERT L. NOVAK, PH.D., *Assistant Professor of Biochemistry*
WILLIAM B. NULSEN, M.S., *Professor of Electrical Engineering*
DAVID P. OLSON, M.S., PH.D., *Assistant Professor of Forest Resources*
WENDELL E. ORR, M.A., *Assistant Professor of Music*
CHARLES W. OWENS, PH.D., *Assistant Professor of Chemistry*
STUART PALMER, M.A., PH.D., *Professor of Sociology*
-

-
- LINCOLN C. PEIRCE, PH.D., *Professor of Plant Science*
NOBEL K. PETERSON, M.S., PH.D., *Associate Professor of Soil and Water Science*
- JOSEPH J. PETROSKI, M.ED., D.ED., *Associate Professor of Education*
FRANK L. PILAR, M.S., PH.D., *Associate Professor of Chemistry*
GERALD J. PINE, M.ED., D.ED., *Associate Professor of Education*
KEITH POLK, M.M., *Assistant Professor of Music*
SOLOMON POLL, M.A., PH.D., *Associate Professor of Sociology*
ALLAN B. PRINCE, PH.D., *Professor of Soil and Water Science*
JAMES RADLOW, M.SC., *Professor of Mathematics*
M. ELIZABETH RAND, M.ED., *Associate Professor of Home Economics*
R. MARCEL REEVES, M.S., PH.D., *Assistant Professor of Entomology and Forestry*
- HERMANN W. RESKE, M.A., PH.D., *Professor of German*
AVERY RICH, M.S., PH.D., *Professor of Botany*
MATHIAS C. RICHARDS, PH.D., *Professor of Botany*
EDYTHE T. RICHARDSON, M.S., *Professor Emeritus of Zoology*
JOHN C. RICHARDSON, M.A., PH.D., *Associate Professor of English*
JOSEPH RIKER III, M.S., PH.D., *Assistant Professor of Animal Science*
RICHARD C. RINGROSE, PH.D., *Professor of Poultry Science*
OWEN M. ROGERS, M.S., PH.D., *Associate Professor of Plant Science*
SAM ROSEN, M.A., PH.D., *Professor of Economics*
SHEPLEY L. ROSS, M.A., PH.D., *Associate Professor of Mathematics*
KENNETH J. ROTHWELL, M.A., PH.D., *Associate Professor of Economics*
DOUGLAS G. ROUTLEY, M.S., PH.D., *Associate Professor of Plant Science*
STEVENSON C. ROWLEY, M.B.A., *Assistant Professor of Business*
- Administration*
- EDWARD F. RUTLEDGE, PH.D., *Assistant Professor of Psychology*
FREDERICK SAMUELS, M.A., PH.D., *Assistant Professor of Sociology*
JOHN L. SANBORN, M.S., PH.D., *Assistant Professor of Civil Engineering*
JOHN J. SASNER, M.S., PH.D., *Assistant Professor of Zoology*
GODFREY H. SAVAGE, M.S., *Associate Professor of Mechanical Engineering*
ALBERT K. SAWYER, M.S., *Associate Professor of Chemistry*
PHILIP J. SAWYER, M.S., PH.D., *Associate Professor of Zoology*
PAUL E. SCHAEFER, M.S., PH.D., *Associate Professor of Zoology*
RICHARD W. SCHREIBER, M.S., PH.D., *Associate Professor of Botany*
ERNST J. SCHREINER, PH.D., *Adjunct Professor of Forestry*
CHARLES B. SCHRIVER, M.S., PH.D., *Assistant Professor of Chemical Engineering*
- J. HOWARD SCHULTZ, M.A., PH.D., *Professor of English*
JAMES H. SCHULZ, PH.D., *Assistant Professor of Economics*
ALEX SHIGO, M.S., PH.D., *Adjunct Associate Professor of Botany*
SAMUEL D. SHORE, M.A., PH.D., *Assistant Professor of Mathematics*
RALPH F. SIBLEY, A.B., PH.D., *Assistant Professor of Psychology*

-
- ROBERT J. SILVERMAN, M.S., PH.D., *Professor of Mathematics*
ROBERT E. SIMPSON, M.A., PH.D., *Assistant Professor of Physics*
WINTHROP C. SKOGLUND, M.S., PH.D., *Professor of Poultry Science*
RICHARD H. SKUTT, M.S., PH.D., *Associate Professor of Electrical Engineering*
LAWRENCE W. SLANETZ, PH.D., *Professor of Microbiology*
ROGER P. SLOAN, M.P.A., *Assistant Professor of Forest Resources*
GERALD L. SMITH, M.S., *Associate Professor of Animal Science*
PHILIP M. SMITH, M.Ed., *Assistant Professor of Education*
SAMUEL C. SMITH, M.S., PH.D., *Associate Professor of Biochemistry and
Poultry Science*
BURTON C. STAUGAARD, M.S., PH.D., *Assistant Professor of Zoology*
DONALD E. STEELE, M.A., *Professor of Music*
SAMUEL E. STOKES, JR., M.A., PH.D., *Associate Professor of French*
E. HOWARD STOLWORTHY, B.S., *Professor of Mechanical Engineering*
DEBORAH E. STONE, ED.M., *Assistant Professor of Education*
KERWIN C. STOTZ, M.S., PH.D., *Associate Professor of Electrical Engineering*
RICHARD G. STROUT, M.S., PH.D., *Associate Professor of Poultry Science*
EMERY F. SWAN, PH.D., *Professor of Zoology*
GUY TARTELIN, C.A.P.E.S., *Visiting Assistant Professor of French*
ARTHUR E. TEERI, M.S., PH.D., *Professor of Biochemistry*
JACOB J. UEBEL, M.S., PH.D., *Assistant Professor of Chemistry*
DALE S. UNDERWOOD, M.A., PH.D., *Professor of English*
WILLARD E. URBAN, JR., M.S., PH.D., *Assistant Professor, Agricultural
Experiment Station*
RUSSELL L. VALENTINE, M.S., *Associate Professor of Mechanical Engineering*
MEENAKSHISUNDER VENKATESAN, M.S., PH.D., *Assistant Professor of
Business Administration*
ROBERT P. VREELAND, M.S., M.E., *Associate Professor of Civil Engineering*
OLIVER P. WALLACE, SR., M.F., PH.D., *Associate Professor of Forest Resources*
TUNG-MING WANG, M.S., *Professor of Civil Engineering*
PETER WARING, M.A., S.M.D., *Associate Professor of Music*
ROBERT WATSON, PH.D., *Professor of Psychology*
JAMES H. WEBER, PH.D., *Assistant Professor of Chemistry*
LAURANCE E. WEBBER, M.S., *Research Professor, Engineering Experiment
Station*
ROBERT G. WEBSTER, M.A., *Professor of English*
RICHARD R. WEYRICK, M.F., *Assistant Professor of Forest Resources*
CHARLES M. WHEELER, JR., M.S., PH.D., *Associate Professor of Chemistry*
DOUGLAS L. WHEELER, M.A., PH.D., *Assistant Professor of History*
JOHN B. WHITLOCK, M.A., PH.D., *Associate Professor of Music*
JOHN D. WICKS, M.A., PH.D., *Associate Professor of Music*
THOMAS A. WILLIAMS, JR., M.A., *Associate Professor of English*
ROBIN D. WILLITS, PH.D., *Associate Professor of Business Administration*
ALDEN L. WINN, M.S., *Professor of Electrical Engineering*
-

WILLIAM G. WITTHOFT, S.M., PH.D., *Assistant Professor of Mathematics*
JOHN WOODRUFF, M.A., PH.D., *Associate Professor of Political Science*
RUTH J. WOODRUFF, M.A., PH.D., *Professor of Economics*
PAUL A. WRIGHT, M.A., PH.D., *Professor of Zoology*
DWAYNE E. WRIGHTSMAN, M.B.A., PH.D., *Assistant Professor of Finance*
FREDERIC W. WURZBURG, PH.D., *Associate Professor of Political Science*
MARJORY A. WYBOURN, M.A., ED.D., *Professor of Home Economics*
W. TSENG YANG, M.S., PH.D., *Assistant Professor of Mechanical Engineering*
YIN-CHAO YEN, M.S., PH.D., *Adjunct Professor of Chemical Engineering*
O. T. ZIMMERMAN, M.S.E., PH.D., *Professor of Chemical Engineering*
J. HAROLD ZOLLER, PH.D., *Professor of Civil Engineering*

Committees of the Graduate School

Graduate Council

President JOHN W. McCONNELL, Dean EUGENE S. MILLS (*Chairman*),
Associate Dean WILLIAM H. DREW, Professors ALEXANDER R. AMELL, MIYOSHI IKAWA,
ROLAND B. KIMBALL, CHARLES H. LEIGHTON, M. EVANS MUNROE,
SAM ROSEN, PAUL A. WRIGHT.

Graduate Scholarships

Professors DONALD W. MELVIN (*Chairman*), JOHN J. SASNER, SAMUEL C.
SMITH, ROBIN D. WILLITS.

Regulations of the Graduate School

Graduate Degree Programs

Master of Science

Animal Sciences
Biochemistry
Biology
Botany
Chemical Engineering
Chemistry
Civil Engineering
Electrical Engineering
Entomology
Forest Resources
Genetics
Geology
Home Economics
Mathematics
Mechanical Engineering
Microbiology
Music Education
Physics
Plant Science
Resource Economics
Soil and Water Science
Zoology

Master of Arts

Economics
English
French
German
History
Music
Political Science
Psychology
Sociology
Spanish

Master of Arts in Teaching

Department of Education

Master of Science for Teachers

Chemistry
English
French
German
Mathematics
Physics
Spanish

Master of Agricultural Education

Department of Agricultural Education

Master of Business Administration

Whittemore School of Business and Economics

Master of Education

Department of Education

Master of Public Administration

Department of Political Science

Doctor of Philosophy

Biochemistry
Botany
Chemistry
Genetics
Mathematics
Microbiology
Physics
Plant Science
Psychology
Zoology

General Information

The Graduate School, which has offered instruction since 1903, has for its objective the bringing together of faculty and qualified students in a spirit of scholarship and research. The graduate student is given opportunity to specialize in some field of knowledge, and to develop a maturity of thought and attitude toward his professional field, so that both his professional and his cultural life are enhanced.

The work of the Graduate School is under the general direction of the Graduate Faculty. The Dean of the Graduate School is responsible for the administration of the regulations and requirements pertaining to admission, conduct of work, the granting of advanced degrees, and other pertinent matters.

General Regulations

Admission

Admission to the Graduate School may be granted to graduates of all colleges and universities of approved standing, provided their undergraduate records are satisfactory. Before entering upon graduate work the applicant must present evidence that he has had the necessary prerequisite training which will enable him to pursue with benefit the courses desired. A candidate for admission must have had a cumulative undergraduate record of not less than a 2.5 grade-point average on a grading scale in which A equals 4.0, B equals 3.0, C equals 2.0, D equals 1.0, or the equivalent, for his undergraduate program of study. In addition the candidate for admission may be required to take an achievement test, where the department in which the candidate plans to do his work so requires. These general requirements for admission to the Graduate School are in addition to the special requirements set up by individual departments or programs. For the individual departmental requirements, see the description under the departmental offerings in this bulletin.

A student who desires to register for graduate study must submit to the Dean of the Graduate School the official application for admission to graduate study. Forms for this purpose may be obtained by writing to the Dean of the Graduate School, University of New Hampshire, Durham, New Hampshire. The application must be accompanied by two official transcripts of the students undergraduate work and of any previous graduate work, and by two letters of reference. Transcripts of applicants who are admitted to graduate study become a permanent part of the University files and will not be returned.

General Regulations

Students wishing to enroll in the M.S.T. program must meet the following admission requirements:

- (a) Education courses sufficient for certification, or
- (b) three years' experience in teaching, or
- (c) current full-time participation in teaching.

Completed applications for admission to the Graduate School should be submitted before July 15 for the first semester, before November 15 for the second semester, and before April 1 for the Summer Session to guarantee action before the respective registration days. Applications will be accepted after the dates mentioned above provided that the applications are accompanied by complete official transcripts; but it may be necessary in such instances to postpone the evaluation of credentials and the determination of requirements until after the registration period. Students wishing to apply for financial aid must submit their applications for admission prior to February 15.

Foreign students applying for admission to the Graduate School should include proof of their ability to handle the English language. Such students should take the "Test of English as a Foreign Language" administered by the Educational Testing Service, Princeton, New Jersey.

All regularly enrolled graduate students must have a medical history and physical examination report on file with the Director of the University Health Service. Recent graduates of the University of New Hampshire need not file a new set of reports upon being admitted to the Graduate School. Others should obtain the proper forms from the Dean of the Graduate School.

Admission to the Graduate School does not imply admission to candidacy for a degree. No graduate student is admitted to candidacy for a degree until he has been in residence a sufficient time to enable his instructors to judge his ability to carry on graduate work. Generally this period of time shall be not less than that required for the completion of 12 credits of graduate work for the Master's Degree, and the passing of the qualifying examination and the completion of departmental language requirements for the Ph.D. degree. Admission to candidacy for a degree will be determined by the Dean upon the recommendation of the department concerned. The student will be notified by the Dean, in writing, of the decision made.

A student admitted to graduate study must have his program approved by the chairman of his department or of his guidance committee and the Dean of the Graduate School. Registration is held prior to the beginning of classes each semester and on the first day of Summer Session. Consult the calendar in this bulletin for the dates of registration.

Graduate students are defined as those who meet the requirements for

admission to the Graduate School and are registered for an approved program for graduate credit.

The maximum graduate load allowed is 16 semester credits for a regular semester, seven credits for a six-week Summer Session and nine credits for an eight-week Summer Session. Only under unusual circumstances will excess credits be allowed, and then only with the approval of the Dean of the Graduate School.

Graduate Credits

Graduate credits may be earned only in courses numbered from 600 through 898, and in the thesis, but graduate credits will not be given in any courses so numbered which are open to freshmen or sophomores.

Graduate students who desire to do a part of their work during the Summer Session of the University will find graduate courses offered in many departments. Credit in appropriate courses may be used in fulfilling the requirements for an advanced degree. For complete information on the Summer Session see the Summer Session issue of the Bulletin of the University of New Hampshire.

Qualified senior students in the University of New Hampshire may be admitted to the Graduate School, and must have been admitted before taking courses for graduate credit. Such seniors may not substitute courses for which they registered in an undergraduate program for those which they registered in a graduate program.

Students holding the baccalaureate degree who have not been admitted to the Graduate School, but who wish to register for graduate courses, must receive the approval of the Dean of the Graduate School and of the instructor concerned.

An incomplete grade in the Graduate School must be made up within a year after the course was to have been completed. This rule does not apply to the completion of the thesis.

The student must meet the special requirements of the department in which he is doing his graduate work and his program must be approved by his adviser and the Dean of the Graduate School. For these special requirements see the department statements in this bulletin.

Tuition

The tuition is \$480 a year for residents of New Hampshire, and \$1,375 a year for non-residents. Tuition rates in the Summer Session and for courses offered by the University Extension Service are listed in their respective catalogues. It should be noted that liberal financial aid is available to graduate students.

Any student registering for eight credits or more per semester will pay the full semester tuition. Any student registering for fewer than

General Regulations

eight credits per semester shall pay \$22.50 per credit hour. In certain instances Graduate Assistants may be exempted from payment of tuition.

A doctoral student who is registered for fewer than eight credits and is pursuing research for the dissertation shall pay by the credit hour, plus a research charge of \$50 a semester. If registered for research only, the charge of \$50 a semester will be applicable and will carry with it the privilege of attending seminars. A doctoral student is defined as one who has completed 30 graduate credits with a grade of B or better, or has received a Master's degree.

When a doctoral candidate completes his requirements *in absentia*, a charge of \$50 for the privilege of taking the final examination must be paid six weeks before the conferring of the degree.

A Memorial Union assessment of \$6.00 per semester must be paid by each student.

The immediate families of members of the University staff may register as full or part-time students in the Graduate School at one-half the current tuition or course rate. They are required, however, to pay the full research fee, if doctoral students.

The University reserves the right to adjust charges for such items as tuition, board, and room rent from time to time. Such changes will be held to a minimum and will be announced as far in advance as feasible.

Assistantships, Scholarships and Fellowships

Approximately 150 graduate assistantships are available each year. Such assistantships are awarded only to superior students. The re-appointment of a Graduate Assistant is contingent on the maintenance of a high level of scholarship. The service required of the Graduate Assistant may be in the nature of (a) teaching assistance, (b) research assistance, or (c) general service.

There are two categories of regular assistantships available. The recommended conditions of employment for each category are as follows:

1. \$2400 for the academic year for an approved schedule of part-time service to the Department. Normal academic program: 9 semester hours per semester. Exemption from payment of tuition may be granted for the academic year and the following Summer Session on recommendation of the department chairman.

2. \$3360 (10 months at \$240, 2 months at \$480) for the fiscal year for

Assistantships, Scholarships and Fellowships

part-time service during the academic year, and full time during the summer with one month of vacation. Normal academic program: 9 semester hours per semester. Exemption from payment of tuition for the regular academic year may be granted on the recommendation of the department chairman.

Inquiries regarding assistantships should be addressed to the chairman of the department concerned.

Scholarships and fellowships ranging in value from remission of tuition to over \$5,000 per year are available to qualified graduate students.

Up to fifty superior students may be granted tuition scholarships. These awards are subject to the maintenance of a high scholastic record in the Graduate School and may be revoked at the end of any semester if the student does not merit such exemption for the subsequent semester. Foreign students will be considered for scholarship awards.

Up to thirty superior students, who have been regularly admitted to the Graduate School, may be granted exemption from Summer Session tuition.

A limited number of three-year fellowships, called University of New Hampshire Fellowships, are awarded to outstanding doctoral students. Each recipient is given an opportunity to spend the first year in full-time study, the second year as a teaching assistant, and the third year as a research assistant. The stipends for this program are \$2,400 for the first year, \$2,600 and \$2,800 for the second and third year respectively. In addition, the award provides \$680 of support for each of two summers, waiver of tuition, and an annual allotment of \$500 each for as many as two dependents.

A limited number of Alumni Fellowships are available to students following a graduate program in the social sciences and humanities. The stipend is \$3,000 per academic year.

A limited number of three-year traineeships sponsored by the National Aeronautics and Space Administration are available for students studying for the Ph.D. degree in Botany, Chemistry, Genetics, Mathematics, Physics, and Zoology. The basic stipend is \$2,400 plus remission of tuition for twelve months' study. In addition, up to \$1,000 may be awarded for dependency and escalation.

Graduate students also are eligible for fellowship awards granted by the National Science Foundation, the Public Health Service, the United States Office of Education, the Woodrow Wilson Foundation, and other national agencies and foundations.

The George F. Dwinell Memorial Fellowship Fund of the New Hampshire Cancer Society, Inc., is provided, on a yearly basis, to promote the interest of young people in investigative work on growth. Selection of the recipients of these awards is determined by a University Committee.

Assistantships, Scholarships, and Fellowships

A limited number of Summer Fellowships for Teaching Assistants is available for students who have held teaching assistantships during the previous academic year. The stipend for summer study is \$680.

Information and application forms concerning all of the above scholarship and fellowship programs may be obtained from the Dean of the Graduate School.

Properly qualified scholars, who may desire temporarily the privileges of the library and research facilities of the University, and who are not candidates for a degree, may, upon recommendation of the Dean of the Graduate School and the approval of the President of the University, be appointed Honorary Fellows without stipend. Honorary Fellows shall not be required to pay any charges except possibly the cost of unusually expensive supplies or equipment.

Requirements for the Master's Degree

For the degrees of Master of Arts, Master of Science, Master of Agricultural Education, Master of Business Administration, and Master of Public Administration, at least 30 credits must be earned, including a minimum of eight credits in courses, not including thesis, numbered 800-898. Courses numbered 600-699 cannot be used towards these Master's degrees if the courses are given in the department awarding the degree. No more than 12 credits will be permitted in courses numbered 600-699. The major department will prescribe for its students the courses which make up the degree program. Somewhat different requirements are obtained for the Master of Science for Teachers degree and it is recommended for this degree, as well as for all other Master's degrees, the appropriate departmental section of the catalog be consulted.

A student will normally spend at least one calendar year, or the equivalent in satisfying the requirements for the degree. No more than 12 credits not including thesis, may be earned off campus. Of these 12, only 6 may be from another graduate school.

All graduate work for any Master's degree must be completed in not more than eight years from the time of registration for the first work taken for the degree.

Students in the Master's degree programs must earn a grade of A or B in all courses for which a letter grade is given. The grade of Cr. (credit) is given for the thesis. Any graduate student who receives a grade of below B in nine or more credits will be required to withdraw from the Graduate School.

Requirements for the Master's Degree

In any department or program requiring a final examination for the Master's degree, the examination may be oral, written, or both. A candidate will be permitted only two opportunities to take the final examinations for the Master's degree, and the time of these examinations will be at the convenience of the department concerned, except that all such examinations must be given at least two weeks before the Commencement date in the year in which the degree is to be conferred. Further regulations governing the final written examination, when required, will be made by the department concerned, subject to the approval of the Dean of the Graduate School. Oral examining committees, when required and not otherwise provided for, will be appointed by the Dean of the Graduate School upon the recommendation of the department concerned. The Dean of the Graduate School, is, *ex officio*, a member of all examining committees.

A student may present for credit a maximum of six credits earned at another graduate school provided that these credits are of a grade of at least B or the equivalent. These will be applied toward the degree only if approved by the major department and the Dean of the Graduate School.

Thesis

A thesis may be required of candidates for the Master of Arts or the Master of Science degrees. Consult the departmental statement for thesis requirements.

The thesis must be approved by a committee of three, comprising the instructor under whose direction it was written and two other members of the Graduate Faculty selected by the department chairman and approved by the Dean of the Graduate School.

Each department will determine the date when the candidate must submit for approval a statement of the subject of the thesis and the date when the thesis must be completed.

The number of thesis credits may vary from six to ten, subject to the approval of the student's adviser.

No thesis credit shall be given until the completed thesis has been approved by the committee on the thesis. No letter grade shall be given for the thesis, but its satisfactory acceptance will be recorded with a Cr. (credit).

The student should obtain from the Graduate School office the latest mimeographed regulations for the form and typing of theses.

Whenever a thesis is printed, it must be designated as having been accepted as a Master's thesis by the University of New Hampshire.

Two copies of the approved thesis, ready for binding, shall be turned in to the Graduate School office not less than two weeks before Commencement, together with a receipt for the binding fee from the University

Requirements for the Master's Degree

Bookstore. Most departments require one copy of the thesis in addition to the above-mentioned two copies. (See departmental requirements in this bulletin.)

Requirements for the Doctor's Degree

The degree of Doctor of Philosophy is conferred on qualified candidates who have passed an oral or written examination on the subject matter of their field of study, who have completed an original investigation in this field and have embodied the results in an acceptable dissertation, and who have passed an oral examination in defense of the dissertation. The degree of Doctor of Philosophy is essentially a research degree. It is not given merely for the completion of course credits. Graduate programs leading to the degree of Doctor of Philosophy are offered in Biochemistry, Botany, Chemistry, Genetics, Mathematics, Microbiology, Physics, Plant Science, Psychology, and Zoology.

All resident predoctoral students must register each semester until requirements for the degree have been completed. The minimum requirement for the doctorate is three years beyond the bachelor's degree. Resident graduate work done at other universities may be counted toward the minimum requirement upon approval of the Guidance Committee and the Dean of the Graduate School but one full academic year must be in residence at the University of New Hampshire. In individual cases, the major department and the Dean of the Graduate School may grant permission to pursue the research for the dissertation at another institution where access to special facilities may be advantageous.

General Requirements

A student working for the Ph.D. degree must earn grades of A or B in all the courses required by his guidance committee. Certain courses may be taken for audit. A grade of Cr. (credit) is given for the completed dissertation.

When the student declares his intention to proceed to candidacy for the degree of Doctor of Philosophy, the department of intended major concentration shall notify the Dean of the Graduate School, who then, upon recommendation of the department, will appoint a guidance committee. This committee will assist the student in outlining his program and in preparing him for his qualifying examination. To prepare him for the qualifying examination and successful pursuit of his research and course work, the guidance committee may require him to take additional course work, with or without credit.

Requirements for the Doctor's Degree

At the time of application by the student for the qualifying examination, a doctoral committee will be appointed to supervise the qualifying and final examinations and to pass on the dissertation. This committee shall be nominated by the department of major concentration and appointed by the Dean of the Graduate School. It shall consist of a minimum of five members, usually three from the major department and two from related departments, and the Dean of the Graduate School, *ex officio*.

The qualifying examination may be written or oral, or both. This examination will test: (1) the student's general knowledge in his major and minor work, and (2) his fitness for engaging in research, particularly in the subject proposed for the dissertation. The results of the examination will be communicated by the chairman of the major department to the Dean of the Graduate School.

The student may not be advanced to candidacy for the Ph.D. until he has passed the qualifying examination and such language requirements as are deemed desirable by the major department. The proposed subject of the student's dissertation must be declared at the time of application for advancement to candidacy. Resident full-time members of the University of New Hampshire faculty with rank of Assistant Professor or higher may not be admitted to candidacy for the Ph.D. at this University.

The dissertation must be a mature and competent piece of writing, a contribution to knowledge, embodying the results of significant and original research.

A copy of the completed dissertation must be made available to the Dean of the Graduate School and to the members of the examining committee two weeks before the final examination date. Following the examination and two weeks prior to Commencement, two copies of the approved thesis, ready for binding, shall be turned in to the Graduate Office, together with a receipt for the binding fee from the University Bookstore. Publication of the dissertation by University Microfilms will be required, and the cost will be assumed by the student. If the material presented in the dissertation is published, it should be designated as having been accepted as a doctoral dissertation by the University of New Hampshire.

The final oral examination is conducted by the doctoral committee and is intended to give the candidate an opportunity to defend his dissertation. A written final examination, on subject matter not covered in the qualifying examination, may also be required. This written examination is conducted by the major department. The final examinations must be completed at least two weeks prior to the date of receiving the degree. After consultation with the major department, the Dean may appoint, for participation in the final oral examination, additional members of the faculty under whom the student has worked. The doctoral committee alone shall decide on the merits of the candidate's performance by a majority vote.

University Services

The Counseling and Testing Center provides, without charge, and through a professionally qualified staff, a range of psychological services to students who are experiencing a persistent personal or emotional difficulty, or some disruption in their academic lives. The services of the office are not limited to those with "serious" problems, but are geared to the needs of the typical college student. Diagnostic services, with the assistance of a consulting psychiatrist, are also available to students whose needs go beyond the scope of our own facilities. In such cases, treatment planning and/or referral to outside sources are provided.

The office administers the freshman testing program, required of all incoming students. Individual clinical testing is also available for personality assessment when students are trying to establish both appropriate goal and an increased sense of their strengths and weaknesses.

Students interested in using the services can make appointments in person at the Center, Room 4, Thompson Hall, or by calling Extension 259. Counseling discussions are, of course, held in professional confidence.

The University Health Service, located in Hood House, is devoted to the protection, improvement, and maintenance of student health. Graduate students carrying eight or more credits and graduate assistants are eligible for treatment. A well-equipped outpatient clinic for diagnosis and treatment of ambulatory patients and modern infirmary of twenty-six beds with an isolation division for communicable diseases is available for students who require inpatient care. During the regular academic year registered nurses are on duty at all times and Hood House is open twenty-four hours daily. Individual health guidance is given through personal conferences with the University physicians. Routine office hours of the University physicians are from 9:00 a.m. to 12:00 noon and 1:30 p.m. to 4:00 p.m. daily, except Saturdays and Sundays when emergency care is available.

The Health Service is closed when the University is officially closed for holidays, closing one hour after dormitories are secured, and opening at 3:00 p.m. on the day before classes resume. During the summer session, Hood House is open Monday through Friday, 8:00 a.m. to 4:00 p.m.

Injury and illness which require hospital confinement, services of specialists, operations, ambulance service, special nurse, or special prescriptions are at the expense of the student. Bed patients at Hood House are charged \$5.00 per day.

In addition to the health service available through Hood House, group accident and sickness insurance, giving twelve-months coverage, is available to students at the University. This insurance coverage is designed to supplement the program of the University. Complete details may be had on application to the Business Office, Thompson Hall.

University Services

The Memorial Union is a campus center for outside-the-classroom activities for the University community. It provides social, recreational, and educational meeting rooms, games rooms, and meals and snacks, as well as headquarters for a number of student organizations. The Union staff reserve rooms for organizations to meet in the Memorial Union and in other University buildings and serve as a central source of campus information. A program of activities for all students is planned by the all-student board of governors of the Memorial Union Student Organization.

The Memorial Union is a gift of the citizens of New Hampshire, the students, the alumni, the faculty and staff, and other friends of the University. The building serves three principal purposes: as a living memorial to the men and women of the State of New Hampshire who have sacrificed their lives in our armed forces, as a college union, and as a state-wide conference center.

The objective of the University Placement Service is to assist students in obtaining summer and permanent employment. The office maintains contact with recruiting personnel from business, industry, government, and education, and keeps files on positions available as well as vocational information about employing organizations. Also available is vocational counseling as an adjunct to the faculty-student guidance relationship.

Students receiving degrees in February, June or August should complete the placement registration procedure in September. Registration is important, and should be completed by the student while on campus, even though permanent employment is not sought immediately after graduation. An on-campus interview program functions between November and March. The services of University Placement are also available to alumni of the University.

Those individuals who have received an advanced degree from the University of New Hampshire automatically become members of the Alumni Association. The present membership of the Association exceeds 24,000 men and women who represent New Hampshire College and University of New Hampshire classes from 1896 through the present. Alumni reside in every state of the Union as well as in many foreign countries.

Governed by a Board of Directors of 15 elected and 4 *ex officio* members, who are the elected Alumni Trustees, the alumni are organized by classes and clubs. Class reunions are held annually. An annual Homecoming Day in the fall provides opportunity for alumni to return to Durham while the University is in session. Other alumni gatherings on campus are also scheduled from time to time during the academic year. There are 50 UNH alumni clubs throughout the United States. A bi-monthly magazine, "The New Hampshire Alumnus," circulates news of students, faculty, alumni, and the University to subscribers. From offices

University Services

in Alumni House on the campus, the Association's activities are directed by a permanent Director of Alumni Affairs and his staff.

The University operates four residence halls for Graduate Students and can accommodate approximately 180 single men and 140 single women. A limited number of the accommodations are double rooms, while the majority are single rooms.

Graduate students may occupy their quarters during Thanksgiving, Christmas and Easter vacation periods.

The new graduate residence hall comprised of twin towers, one for 90 men and the other for 90 women, has common lounge and recreation facilities. The towers, containing all single rooms, are served by elevators and have seminar and study rooms on each floor. In addition, laundry facilities, storage rooms, a complete snack vending area, TV lounge, and post office are located in the building.

This new facility will be available during the fall of 1967.

Off-campus accommodations are best secured by personal survey and the University Housing Office maintains partial listings of available rentals. Students may review these listings during normal business hours at the Housing Office. The University, however, can assume no responsibility for living accommodations contracted between landlords and individuals. For married personnel, the University operates Forest Park Apartments, a limited number of which are available to graduate students.

Requests for applications for housing should be made directly to University Housing, Stoke Hall. Assignments to residence halls are made on the basis of date of application and are for the entire academic year.

The University Dining Services operates a cafeteria in Memorial Union Building where meals may be obtained on an a la carte plan. Graduate Students may also purchase a semester meal ticket which would provide twenty-one (21) meals weekly for the entire semester. Meal tickets are good only in two Dining Halls — Stillings or Huddleston.

Departmental Requirements and Description of Courses

IBM Key Codes

The following numbers are used extensively in machine-processed data to identify both undergraduate and graduate programs offered at the University. An asterisk preceding the number identifies those departments which offer graduate programs.

College of Liberal Arts

- 40 Liberal Arts non-departmental
- *41 Biological Sciences Division
- 42 Education Division
- 43 Humanities Division
- 44 Physical Sciences Division
- 45 Social Sciences Division
- 46 The Arts
- *47 Microbiology
- *48 Education
- *49 English
- 50 Geography
- *51 Geology
- *52 Government
- *53 History
- 55 Foreign Language and Literature
 - *56 French
 - *57 German
 - 54 Nursing
 - 58 Greek
 - 59 Italian
 - *60 Latin
 - 61 Russian
 - *62 Spanish
 - *63 Music
 - 64 Music Education
 - 65 Occupational Therapy
 - 66 Philosophy
 - *67 Psychology
 - *68 Sociology
 - 69 Speech and Drama
 - *70 Zoology

College of Agriculture

- 20 Agriculture non-departmental
- *21 Resource Economics
- *22 Agricultural and Extension Education
- *23 Soil and Water Science
- *25 Animal Sciences
- *26 Biochemistry
- *27 Botany
- *29 Entomology
- *30 Forestry
- *31 Home Economics
- *32 Plant Sciences

College of Technology

- 79 Technology non-departmental
- *80 Chemical Engineering
- *81 Chemistry
- *82 Civil Engineering
- *83 Electrical Engineering
- *84 Mathematics
- *85 Mechanical Engineering
- *86 Physics

Whittemore School of Business and Economics

- 74 Hotel Administration
- *71 Business Administration
- *72 Economics
- 73 Secretarial Studies

Agricultural Education (22)

William H. Annis, *Program Chairman*

The degree of Master of Agricultural Education is designed for teachers of agriculture, County Cooperative Extension personnel, and others in adult education.

A comprehensive examination will be required of all candidates for this degree.

(792). PLANNING FOR TEACHING

The organization of materials of instruction to meet group and individual needs. Techniques of instruction, planning for teaching, the function of consulting committees, working with youth groups, and program evaluation. This course is scheduled concurrently with Ag. Ed. 794 and 795. Mr. Annis. Prereq: Ag. Ed. 650 or permission of instructor. 4 cr.

(794). SUPERVISED PRACTICE

Supervised practice in the specific and related problems of agricultural education. Students will be placed in Vocational Agriculture Centers and County Cooperative Extension Service Centers. Mr. Annis. Prereq: Ag. Ed. 650 or permission of instructor. 2-11 cr.

795. PREPARATION FOR CONDUCTING AND SUPERVISING ADULT EDUCATION PROGRAMS

The techniques of adult education in terms of identifying needs, program planning, methods of teaching, supervision, and evaluation. Mr. Annis. Prereq: Ag. Ed. 650 or permission of instructor. 3 cr.

796. SEMINAR IN AGRICULTURAL AND EXTENSION EDUCATION

Library and reference work and the preparation of papers for various phases of agricultural and extension education. Mr. Annis. Prereq: Supervised Practice or 6 hours in Agricultural Education. 1 cr.

797. ADVANCED METHODS AND MATERIALS OF INSTRUCTION

The organization of instruction to meet individual and student needs; development and use of resource files and instructional materials. Evaluation in teaching Vocational Education. Open to teachers of Vocational Education and others by permission of the instructor.

798. SUPERVISION AND ADMINISTRATION OF VOCATIONAL EDUCATION

The Federal and State requirements for vocational education programs in the secondary schools. 2-3 cr. (Offered in 1967.)

799. HISTORY AND PHILOSOPHY OF VOCATIONAL EDUCATION

The development of vocational education in the United States with emphasis on the socio-economic influences responsible for its establishment. Its relationship with general education, together with the coordination of instructional programs in the various vocational fields. 2-3 cr.

Agricultural Education

801. ADVANCED METHODS IN AGRICULTURAL MECHANICS INSTRUCTION

Agricultural mechanics problems and how to approach them in the high school as a part of the course of study in vocational agriculture. The physical setup, as well as the processing of supplies and equipment, methods of supervision and direction of agricultural mechanics projects, and the preparation and presentation of demonstrations. Mr. Gilman. 2 cr. (Offered in 1968.)

802. METHODS IN TEACHING THE OPERATION AND MAINTENANCE OF FARM TRACTORS

Methods of teaching the servicing and maintenance of the various mechanical systems found on farm tractors. Teaching plans, techniques of instruction, and essential skills. Demonstrations, discussions, and laboratory participation will make up a considerable part of the class work. Mr. Gilman. 2 cr. (Offered in 1967.)

803. METHODS IN TEACHING THE CARE AND MAINTENANCE OF AGRICULTURAL MACHINERY

Content includes, in addition to methods in teaching, teaching plans, techniques of instruction, and the essential skills. Demonstrations, discussions, and laboratory participation will make up the balance of the work. Mr. Gilman. 2 cr. (Offered in 1968.)

804. PROGRAM PLANNING IN AGRICULTURAL EDUCATION

The basic problems, principles, and procedures in the process of program planning in vocational agriculture and extension. Mr. Annis. 2 cr. (Offered in 1968.)

805. PLANNED AGRICULTURAL EXPERIENCE PROGRAMS IN VOCATIONAL AGRICULTURE

Development of cooperative relations, selection and development of individual programs with the students, and the supervision and evaluation of such programs. Mr. Annis. 2 cr. (Offered in 1970.)

806. PREPARATION AND USE OF VISUAL AIDS FOR AGRICULTURAL EDUCATION

The purpose of visual aids and the kinds best adapted to use in the program, together with their preparation and use. 2 cr. (Offered in 1969.)

807. ORGANIZATION AND SUPERVISION OF YOUTH ORGANIZATIONS

The purposes and organization of youth organizations, establishing the local organization, planning and developing a program of work, ways and means of improving the local organization, and methods of evaluation. 2 cr. (Offered in 1970.)

809. COMMUNITY ORGANIZATION AND PUBLIC RELATIONS

The composition, purposes, and objectives of the various social and economic organizations operating in local communities. The importance of their membership to the general welfare of the area and the development of a public relations program. 2 cr. (Offered in 1968.)

895, 896, 897. INVESTIGATIONS IN AGRICULTURAL EDUCATION

Individual study problems in various phases of agricultural education.
Prereq: Permission of staff. 2 cr.

899. M.S. THESIS

6-10 cr.

Animal Sciences (25)

(Dairy, Livestock, Poultry)

W. C. Skoglund, *Chairman*

To be admitted to graduate study in Animal Sciences an applicant is expected to have had sufficient undergraduate training in the basic biological sciences to qualify for special work in this field. A thesis is required and a candidate for the Master's degree shall pass an oral examination covering his graduate courses and thesis.

703. ANIMAL GENETICS

Mendelian and quantitative inheritance in animals. Principles and systems of selection. Mr. Collins. Prereq: 3 cr. of genetics or permission of instructor. 2 lec; 1 lab; 3 cr.

705. A REVIEW OF ANIMAL SCIENCE

The principles and practices relating to the feeding, breeding, selection, and management of beef cattle, horses, sheep and swine. For teachers of vocational agriculture and other students with the permission of their advisers. Staff. Summer Session only. Two hours daily, lec. and lab; 2 cr.

706. A REVIEW OF DAIRY SCIENCE

Subject matter covering the principles and practices relating to the latest information on dairy cattle breeding, feeding and management, and the processing and marketing of milk and its products. For teachers of vocational agriculture and other students with the permission of their advisers. Staff. Summer Session only. Two hours daily, lec. and lab; 2 cr.

707. A REVIEW OF POULTRY SCIENCE

The principles and practices relating to the latest information on poultry breeding, feeding, diseases, and management. For teachers of vocational agriculture and other students with the permission of their advisers. Staff. Summer Session only. Two hours daily, lec. and lab; 2 cr.

708. ADVANCED DAIRY SCIENCE

Basic data, fundamental observations, and discussions of research contributing to the present status of the dairy industry. Mr. Moore. Prereq: Adequate preparation in chemistry and bacteriology. 2 cr.

Animal Sciences

710. DAIRY CATTLE NUTRITION AND MANAGEMENT

Feeding and management of dairy animals, calf feeding, raising young stock, and feeding for economical milk production. Mr. Holter. 2 lec; 1 lab; 3 cr.

711-712. INVESTIGATIONS IN DAIRY, LIVESTOCK, POULTRY

1. GENETICS: Mr. Gerald Smith, Mr. Collins, Mr. Boynton.
2. NUTRITION: Mr. Gerald Smith, Mr. Ringrose, Mr. Colovos, Mr. Holter, Mr. Riker.
3. MANAGEMENT: Mr. Skoglund, Mr. Morrow, Mr. Gerald Smith, Mr. Boynton.
4. DISEASES: Mr. Allen, Mr. Corbett, Mr. Dunlop, Mr. Strout, Mr. Samuel Smith, Mr. Beckman.
5. PRODUCTS: Mr. Gerald Smith, Mr. Moore.
6. LIGHT HORSEMANSHIP: Mrs. Briggs, Mr. Beckman, Mr. Riker.
7. PHYSIOLOGY: Mr. Fowler, Mr. Riker.

An opportunity is given for the student to select a special problem in any of the fields listed under the guidance of the instructor. Elective only after consultation with the instructor in charge. Hours to be arranged. 1-3 cr. May be repeated.

801. ADVANCED ANIMAL BREEDING

Practical breeding problems with beef and dual-purpose cattle, sheep, horses, and hogs. The genetic principles important to successful livestock production. Mr. G. L. Smith. 2 lec; 1 lab; 3 cr.

802. MEATS, LIVESTOCK MARKETS, AND PRODUCTS

The essential factors in meat selection, cutting, curing, and smoking; study and discussion relative to the problems of livestock marketing and the procedure in the large central markets. Trips are taken to various packing plants. Mr. G. L. Smith. 2 lec; 1 lab; 3 cr.

803. ADVANCED ANIMAL NUTRITION

Incidental lectures, assigned reading, and laboratory practice in methods of research with major emphasis on protein and energy metabolism. Mr. Colovos. 3 cr.

804. ADVANCED DAIRY CATTLE BREEDING

The analysis and formulating of breeding programs, principles of milk secretion, and factors influencing the quantity and quality of milk. Mr. Boynton. 2 lec; 1 lab; 3 cr.

805-806. AVIAN MICROBIOLOGY

The disease process in the intact host at cellular levels when invaded by viruses or virus-like agents, fungi, and protozoans. Physiological and cytopathological changes in tissue culture. Mr. Dunlop, Mr. Strout, and Mr. Corbett. Prereq: An. Sci. 602 or the equivalent. 3 cr.

807-808. AVIAN HISTOPATHOLOGY

First semester: general histopathology. Second semester: the special histopathology of common diseases with emphasis on tumor and tumor formation. Mr. Dunlop and Mr. Strout. Prereq: Histology or the equivalent. 3 cr.

809-810. ADVANCED POULTRY NUTRITION

Metabolism and the physiology of digestion with emphasis on nutrient needs and deficiency diseases of poultry: Analysis of recent experimental research and current feed problems. Mr. Ringrose. 3 cr.

812. QUANTITATIVE GENETICS AND ANIMAL IMPROVEMENT

Gene frequency, genetic and environmental variation, heritability, fitness, selection, inbreeding, outbreeding, correlated characters. Mr. Collins. Prereq: 3 cr. each genetics and statistics. 3 lec; 3 cr.

897-898. ANIMAL SCIENCE SEMINAR

A survey of recent literature and research in the Animal Sciences. Staff. 1 cr. May be repeated.

899. THESIS

Hours and credits, from 6-10, to be arranged.

Biochemistry (26)

Edward J. Herbst, *Chairman*

Students admitted to graduate study in Biochemistry are expected to have had preparation in the biological sciences, mathematics, physics, and chemistry. The candidate for the M.S. degree will be required to prepare a thesis, and to pass an oral examination covering his graduate courses and thesis.

The Ph.D. degree candidate will be required to demonstrate proficiency in reading biochemical literature in two foreign languages, usually German and French. Each candidate will be expected to demonstrate to the Doctoral Committee a broad basic knowledge of the field of Biochemistry. Candidates will be required to pass examinations established by the Doctoral Committee and to complete a dissertation on original research in Biochemistry.

751. GENERAL BIOCHEMISTRY

The fundamental principles of biochemistry with emphasis on the chemical properties, principal metabolic pathways, and functions of carbohydrates, lipids, and nitrogenous compounds. Mr. Herbst and Mr. Ikawa.

Biochemistry

Prereq: Satisfactory preparation in organic chemistry and quantitative analysis. 3 lec; 2 lab; 5 cr.

756. PHYSIOLOGICAL CHEMISTRY AND NUTRITION

An introductory biochemistry course with emphasis on human physiological chemistry and nutrition. The laboratory includes a study of procedures basic to chemical methods used in medical diagnostic work. Mr. Teeri. Prereq: Satisfactory preparation in organic chemistry. 3 lec; 2 lab; 5 cr.

762. PLANT METABOLISM

The function, occurrence, synthesis, and degradation of plant constituents. Major emphasis will be placed on respiration and photosynthesis and their relationship to the metabolism of lipids and nitrogen compounds. Mr. Routley. Prereq: Biochem. 751 or 756 or equivalent. 2 lec; 1 lab; 3 cr.

811. BIOCHEMISTRY OF LIPIDS

The chemistry, metabolism, and function of lipids. Mr. Smith. Prereq: Biochem. 751 or 756 or equivalent. 2 cr.

821. BIOCHEMISTRY OF AMINO ACIDS

The chemistry, metabolism, and function of amino acids and related substances. Mr. Teeri. Prereq: Biochem. 751 or 756 or equivalent. 2 cr.

832. BIOCHEMISTRY OF CARBOHYDRATES

The chemistry, metabolism and function of carbohydrates and related substances with emphasis on the polysaccharides. Mr. Ikawa. Prereq: Biochem. 751 or 756 or equivalent. 2 cr. (Alternate years; not offered in 1967-1968.)

842. BIOCHEMISTRY OF NUCLEIC ACIDS

The chemistry and metabolism of nucleic acids and their role in protein biosynthesis. Mr. Herbst. Prereq: Biochem. 751 or equivalent. 2 cr. (Alternate years; offered in 1967-1968.)

872. ADVANCED BIOCHEMISTRY LABORATORY

An advanced laboratory course in the purification and physical characterization of biological macromolecules, especially proteins and nucleic acids. The separatory techniques will include various types of chromatography, electrophoresis, and counter current distribution. Ultracentrifugation, spectroscopy, viscometry, and hydrogen-tritium exchange will be among the physical techniques that will be employed to study macromolecular structure. Mr. Novak. 1 lec; 3 lab; 4 cr.

895, 896. GRADUATE PROJECTS

Staff. Prereq: Satisfactory preparation in analytical, organic, and biological chemistry. Subject matter and hours to be arranged. 1-3 cr.

897, 898. BIOCHEMISTRY SEMINAR

Presentation and discussion of recent investigations. Mr. Herbst and staff.
Prereq: Permission of the Department Chairman. 1 cr.

899. M.S. THESIS

To be arranged. 6-10 cr.

999. DOCTORAL RESEARCH

Biology (41)

Paul A. Wright, *Chairman of Committee*

Students admitted to graduate study in Biology must have completed an undergraduate major in Biology or in some field of the biological sciences. Suitable training in the physical sciences is also necessary. Students who lack undergraduate training in any of the fields of the biological sciences may be required to complete certain courses in these fields which do not carry graduate credit before they are admitted to candidacy for a degree.

Graduate work in Biology is under the direction of a committee consisting of the Chairmen of the departments of Botany, Entomology, Microbiology, and Zoology. This committee shall determine, in light of the student's objectives, courses and requirements to be met by the candidate. Candidates for the Master's degree in Biology shall pass a written examination covering their general preparation in the field. With the permission of the Committee and the prospective Supervisor of the Thesis, a student may elect to submit a thesis in partial fulfillment of the requirements of the Master's degree.

791. BIOLOGY-EDUCATION. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY

Objectives and methods of teaching; the selection and organization of materials; the preparation of visual aids; the setting up of aquaria and other projects. The use of the field trip as a tool in teaching high school biology. Mr. Schaefer. Prereq: Two years of biological sciences and Principles of Teaching. 2 rec; 1 lab or field trip; 3 cr.

For listings of other courses see: Botany, Entomology, Microbiology, and Zoology.

Botany

Botany (27)

Albion R. Hodgdon, *Chairman*

Students admitted to graduate study in Botany are expected to have had adequate preparation in basic Botany courses and in the physical sciences. The candidate for the M.S. degree will be required to pass an oral examination and to prepare a thesis. Thesis credits may be from 6 to 10 depending on the research problem involved. Students who are working toward the Ph.D. degree usually are expected to demonstrate a reading knowledge of two foreign languages, preferably French and German, early in their programs, and must complete a thesis-dissertation on some original research in Botany. The subject-matter fields for graduate study in Botany are: Systematic Botany and Plant Ecology, Mr. Hodgdon; Plant Physiology, Mr. Dunn; Plant Morphology and Anatomy, Miss Nast; Plant Pathology, Mr. Rich; Mycology, Mr. Richards; Cytology, Mr. Schreiber; Phycology, Mr. Mathieson.

742. PLANT ECOLOGY

Plant life and its environment, including such factors as light, temperature, soil, water, and biotic relations; associations, successions, and plant forms; plant distribution and underlying causes. Mr. Hodgdon. Prereq: Bot. 411 or Bot. 503. 3 cr.

751. PLANT PATHOLOGY

The nature of disease in plants, the etiology, symptomatology, and classification of plant diseases. Mr. Rich. Prereq: Bot. 411 or Bio. 401. 1 lec; 2 lab; 3 cr.

752. PRINCIPLES OF PLANT-DISEASE CONTROL

Exclusion, eradication, protection, and immunization, and the specific, practical methods used to control plant diseases. Mr. Rich. Prereq: Bot. 751. 1 lec; 2 lab; 3 cr. (Alternate years; offered in 1967-1968.)

754. CYTOLOGY

The structure, physiological behavior, and development of cells. The cellular basis of heredity. Mr. Schreiber. Prereq: One year each in the biological sciences and in chemistry. 3 cr.

755. ADVANCED SYSTEMATIC BOTANY

The principles and laws of plant classification and nomenclature; plant families, field, and herbarium work. Mr. Hodgdon. Prereq: Bot. 506. Hours to be arranged. (Not offered in 1967-1968.)

756. PLANT PHYSIOLOGY

Structure and properties of cells, tissues, and organs; absorption and movement of water; metabolism; growth and irritability. Mr. Dunn. Prereq: Bot. 411 or Bot. 503, and one year of chemistry. 2 lec; 2 lab; 4 cr.

758. PLANT ANATOMY

The anatomy of vascular plants with emphasis on tissue development and structure. Miss Nast. Prereq: Bot. 411 or Bot. 503. 2 lec; 2 lab; 4 cr.

762. MORPHOLOGY OF THE VASCULAR PLANTS

Life histories and evolution of both extinct and living pteridophytes, gymnosperms, and angiosperms, including comparisons of the general structure and sexual organs. Miss Nast. Prereq: Bot. 411 or Bot. 503. 2 lec; 2 lab; 4 cr. (Alternate years; not offered in 1967-1968.)

765. MICROTECHNIQUE

Methods of embedding, sectioning, and staining plant tissues, and introduction to microscopy. Miss Nast. Prereq: Bot. 411 or Bot. 503. 3 cr. (Alternate years; not offered in 1967-1968.)

766. FRESHWATER PHYCOLOGY

Identification, classification, ecology and life histories of the major groups of freshwater algae. Mr. Mathieson. Prereq: Bot. 411 or Bot. 503. 2 lec; 2 lab; 4 cr. (Alternate years; not offered in 1967-1968.)

768. MYCOLOGY

The parasitic and saprophytic fungi, their growth, reproduction, and identification. Mr. Richards. Laboratory and assigned reading. 1 lec; 2 lab; 3 cr.

780. MARINE PHYCOLOGY

Identification, classification, ecology and life histories of the major groups of marine algae. Particular emphasis will be placed upon the New England marine algal flora. Mr. Mathieson. Prereq: Bot. 411 or Bot. 503. 2 lec; 2 lab; 4 cr. (Alternate years; offered in 1967-1968.)

795-796. INVESTIGATIONS IN (1) SYSTEMATIC BOTANY, (2) PLANT PHYSIOLOGY, (3) PLANT PATHOLOGY, (4) PLANT ANATOMY AND MORPHOLOGY, (5) PLANT ECOLOGY, (6) AQUATIC PLANTS, (7) CYTOLOGY, (8) PHYCOLOGY

Elective only upon consultation with the Department Chairman. Mr. Hodgdon, Mr. Dunn, Mr. Rich, Miss Nast, Mr. Schreiber and Mr. Mathieson. Hours to be arranged. 2 to 6 cr.

797-798. BOTANY SEMINAR

Library reference work and the preparation of papers and abstracts. Practice in the preparation of oral and written reports. Botany staff. Pre-req: 6 hours of botany, or permission of the Department Chairman. This course may be repeated for credit. 1 cr.

801. PLANT GEOGRAPHY

The distribution of plants, a consideration of vegetation types and floras and problems of endemism with emphasis on North America; the major influential factors such as geologic, climatic, edaphic, and biotic, includ-

Botany

ing man's activities. The major contributions from Humboldt to the present time. Mr. Hodgdon. 3 cr. (Alternate years; offered in 1967-1968.)

805. ADVANCED PLANT PHYSIOLOGY

Plant physiological phenomena, such as absorption, permeability, mineral nutrition, photosynthesis and light effects, respiration, growth regulator effects. Mr. Dunn. Prereq: Bot. 56 or equivalent, or adequate preparation in the physical sciences. Conferences, laboratory, and assigned reading. 3 or 4 cr. (Alternate years; offered in 1967-1968.)

830. MORPHOGENESIS

The study of form and development as affected by internal and external factors. Miss Nast. Prereq: Bot. 758 and 762. 3 cr. (Alternate years; offered in 1967-1968.)

851. ADVANCED PLANT PATHOLOGY

Advanced theories and methods in plant pathology. Mr. Rich. Prereq: Bot. 751 and permission of the instructor. Assigned reading, conferences and laboratory. 3 cr. (Alternate years; offered in 1967-1968.)

895-896. INVESTIGATIONS IN (1) SYSTEMATIC BOTANY, (2) PLANT PHYSIOLOGY, (3) PLANT PATHOLOGY, (4) PLANT ANATOMY AND MORPHOLOGY, (5) PLANT ECOLOGY, (6) MYCOLOGY, (7) CYTOLOGY, (8) PHYCOLOGY

Elective only upon consultation with the Department Chairman. Mr. Hodgdon, Mr. Dunn, Mr. Rich, Miss Nast, Mr. Richards, Mr. Schreiber and Mr. Mathieson. Hours to be arranged. 2 to 6 cr.

899 (899). M.S. THESIS 6-10 cr.

999 (999). DOCTORAL DISSERTATION

Business Administration (71)

Robert F. Barlow, *Dean*

Whittemore School of Business and Economics

The Whittemore School program leading to the degree of Master of Business Administration is designed to prepare its graduates for professional careers in administration in industrial and other organizations in a rapidly changing world. It provides for knowledge and understanding of management principles and practices through study of (1) the increasing body of relevant knowledge drawn from the behavioral sciences, mathematics and economics, (2) the existing and emerging processes and institutions of the functional fields of business and (3) the role of business and other organizations in an increasingly complex and ever-changing society.

Candidates for admission must normally possess a Bachelor's degree from an accredited college or university. Applicants will generally be expected to have completed their undergraduate programs of study with a cumulative academic average of at least 2.5 or the equivalent. In addition, all candidates are expected to take the Admissions Test for Graduate Study in Business (ATGSB) given by the Educational Testing Service.*

The Whittemore School welcomes applicants with any academic background, but previous work in mathematics, economics, the behavioral sciences, and the various branches of engineering are of particular relevance to graduate study in Business Administration. Because of the increasing use of mathematical concepts, models and notation in the practice and study of business administration, applicants should normally have successfully completed one year of college mathematics through an introduction to the calculus.

In all cases, the applicant's entire educational background, relevant experience, references and professional aims will be considered in the admissions process and exceptions may be made to any of the foregoing requirements by the Committee on Admissions.

The program leading to the Master of Business Administration degree requires two years of full-time study. The first year of the program consists of separate courses integrated into an overall study of the nature of business administration in a rapidly changing environment. In the first semester, the student will be largely concerned with study of concepts and analytical techniques drawn from the basic disciplines, such as economics, mathematics, psychology, and sociology, which underlie business administration. In the second semester, some work in the behavioral and quantitative areas is continued and courses dealing with the functional areas of business are introduced. In these courses the concepts and techniques developed in the early part of the year are utilized in dealing with specific business problems.

The second year continues the emphasis of the first year on overall management by requiring all students to complete the integrating course entitled Policy Formulation and Administration. Special attention is also given in the second year to the changing and increasingly complex external environment in which management functions by requiring all students to complete the course entitled Conceptual Foundations of Business.

In addition, the student will select the equivalent of eight semester courses from among those offered in Business Administration and Economics by the Whittemore School and by other colleges and departments of

* Details concerning times, places, etc., for these examinations may be obtained from Educational Testing Service, Box 966, Princeton, New Jersey 08540.

Business Administration

the University. In selecting these courses the student will normally be expected to develop some concentration by taking at least two semester courses but not more than three semester courses in one of the several designated areas. Where the student elects courses offered by other colleges of the University, such selection requires approval of the Dean.

725. BUSINESS HISTORY

A survey of the development of business enterprise and its institutions in Western Europe and the United States from the late Middle Ages to the era of the giant diversified corporation. Emphasis is placed on the role of the entrepreneur, the impact of public policy on business and the case study of individual firms. Mr. Greenleaf. 3 cr. (This course is the same as Econ. 725 and Hist. 725.)

750. ADVANCED MARKETING MANAGEMENT

A study of the interrelation of marketing with production and finance. Topics include planning and developing the product, testing, brand management, packaging, sales organization, forecasting, and control. Policy formulation and decision making are emphasized. Mr. Marschner. 3 cr.

752. MARKETING RESEARCH

The study of marketing research as a basis of formulating marketing policies and strategy. Topics include research design, methods of collecting data, planning the investigation, sampling methods, motivation research, advertising research, and consumer research. Mr. Venkatesan. 3 cr.

756. FEDERAL TAXATION

Current federal income, estate, and gift taxes and their impact on corporations, partnerships, and individuals. 3 cr.

761. CONTROL AND INFORMATION SYSTEMS

The concepts of systems, their use in enterprise management, and the role and influence of on-line control systems; the nature and uses of information in management. The course includes materials intended to familiarize the student with software techniques and hardware characteristics related to "information technology." Mr. Beckett. 3 cr.

762. COST AND MANAGEMENT

The effective use of cost accounting, cost analysis, and budgeting in planning and controlling operations. Topics considered include analysis of cost behavior, direct and absorption costing, cost-price-volume relationships, distribution costs, transfer pricing, and capital expenditure analysis. 3 cr.

763-764. ADVANCED FINANCIAL ACCOUNTING I AND II

Accounting theory and practice as they contribute to the significance and limitations of the financial statements by which business commun-

Business Administration

cates financial status to interested outsiders. Mr. Horrigan. Permission of Instructor. 3 cr.

774. BUSINESS POLICY

Administrative practice of business management; use of business tools; processes of integrating operations, administering business systems, selecting goals and objectives, and formulating policy. Mr. Beckett. Prereq: Senior standing and permission of instructor. 4 cr.

775. OPERATIONS RESEARCH

Mathematical programming, game theory, inventory, queuing, and scheduling problems, dynamic programming. Mr. Korbel. 3 cr.

776. CONSUMER BEHAVIOR

The consumer-firm relationship studied in terms of concepts drawn from contemporary social science findings, particularly small group studies, as related to present and prospective marketing activities of a business organization. Mr. Venkatesan. 3 cr.

790. SEMINAR IN BUSINESS PROBLEMS

Special topics in business administration. This course may be repeated. Prereq: Consent of the adviser and the instructor. Credits to be arranged.

801. QUANTITATIVE ANALYSIS

Calculus, difference equations and matrix algebra with business applications. 3 cr.

802. QUANTITATIVE ANALYSIS

Probability, sampling, inference, regression, econometric models. 3 cr.

803. HUMAN BEHAVIOR IN ORGANIZATIONS

To provide students with an understanding of behavioral science concepts and their use in the analysis of interpersonal relationships in organizations and to develop sensitivity to the range of possible human behavior in organizations. 3 cr.

804. MANAGEMENT ORGANIZATION

Study of the historical development of theories and structures of organization and analysis of contemporary organization theory and structure. Concern is with development of rational management processes in a dynamic society. 3 cr.

805. MANAGEMENT AND CONTROL

Study of the informational needs of organizations and concepts and techniques for insuring the flow of needed information. Computer operations, elements of accounting and theories and methods of financial and cost control are considered. 3 cr.

806. FINANCIAL MANAGEMENT

Concepts and techniques for determining the need for, the acquisition of and the management of financial resources of the business. 3 cr.

Business Administration

807. ECONOMIC ENVIRONMENT OF BUSINESS

To provide an understanding of national economic activity including output, income, employment and price levels and familiarity with present knowledge of the determinants of economic growth and fluctuations. 3 cr.

808. MARKETING MANAGEMENT

Identification, development and retention of markets for the goods and services offered by the firm. Attention is given to the dynamics of demand and to the blending of the marketing mix. 3 cr.

809. ECONOMICS OF BUSINESS DECISIONS

A study of the economics of the business firm. Primary attention is given to economic concepts which can serve as frameworks for business decisions and economic analytical techniques which are directly useful in decision making. 3 cr.

810. PRODUCTION MANAGEMENT

Concepts and practices in the planning, supervision and control of activities concerned with manufacturing the goods and services of the firm. 3 cr.

811. CONCEPTUAL FOUNDATIONS OF BUSINESS

Study of the modern corporation as a partly economic, partly legal and partly social organization, including examination of widely held views about business and views of businessmen about themselves. 3 cr.

812. POLICY FORMULATION AND ADMINISTRATION

Top management functions of planning, organizing and evaluating the results of actions taken. The general management point of view rather than that of functional departments is stressed and as such continues the integrating approach of the first year. 3 cr.

Chemical Engineering (80)

Oswald T. Zimmerman, *Chairman*

To be admitted to graduate study in Chemical Engineering an applicant shall be expected to have completed a course of study substantially equivalent to that required for the degree of Bachelor of Science in Chemical Engineering in this University. However, students with good undergraduate records but with deficiencies in certain areas may be admitted on condition that they complete specified courses without credit to make up for their deficiencies. A preliminary examination covering basic subjects in chemical engineering and physical chemistry will be given to all enter-

ing graduate students before registration in order to better formulate a meaningful program of study.

A candidate for the Master's degree in Chemical Engineering may choose either to prepare a thesis, for which up to six credits will be allowed, or to take an equivalent amount of course work. In either case he must carry out a literature survey on some research topic approved by his adviser. Those candidates who do not elect to prepare a thesis will be required to take a comprehensive oral examination prior to completion of the M.S. program in place of the customary defense-of-thesis examination.

Courses numbered between 600 and 699 may be taken for graduate credit by non-majors only.

Permission of the instructor and consent of the student's adviser are required for enrollment in all Chemical Engineering courses.

641. PHYSICAL METALLURGY

The nature of metals, emphasizing the quantum mechanical description of the solid-state and including atomic structure, bonding, historical development of metal theories, elementary zone or band theory, and X-ray diffraction. The microscopic metal system, thermodynamics of metallurgical processes, defects and dislocations, phase relations of pure metals and alloys, microstructure, and physical and thermal treatment of metals. Study of some non-metals. 3 lec; 1 lab; 4 cr.

662. CHEMICAL ENGINEERING ECONOMICS AND PLANT DESIGN

The principles of cost engineering, including estimation of plant investment, working capital, operating costs, labor requirements, payout time, and profitability. Value of money, capitalized costs, simple and compound interest, depreciation, taxes and insurance, labor requirements, overhead, financing of chemical enterprises, design of equipment and plants for minimum cost, plant location, transportation, sales cost, equipment cost, and cost indexes. Each class selects one or more problems involving the complete design of a chemical plant. For each problem, the most desirable process must be determined, the site selected, the equipment and plant designed, calculations made for all costs, profitability and payout time, and a complete report prepared, including the drawings of equipment and plant layout. 1 lec or rec; 3 lab; 4 cr.

752. PROCESS DYNAMICS

A basic treatment of process dynamics, including a study of first and second order linear processes and their response to step and sinusoidal driving functions. Graphical analysis of the entire control system is included with special emphasis on the optimum design of a stable system. 3 cr.

781. HIGH POLYMERS

Principles and practice of high polymer manufacture, including indus-

Chemical Engineering

trial polymerization methods and equipment design. Laboratory work includes typical polymerization reactions and the physical and chemical testing of various types of plastics and synthetic fibers. 2 lec or rec; 1 lab; 3 cr.

813. INTRODUCTION TO FLUID DYNAMICS

Equations of change for continuous fluids; laminar Newtonian and non-Newtonian flow; ideal fluid flow; boundary layer methods; turbulence. Prereq: Math. 629. 3 cr.

815. HEAT TRANSFER

Steady-state and transient heat conduction in solids; heat convection; analytic solutions, similarity relations, boundary layer methods; radiation. Prereq: Math. 629. 3 cr.

816. DIFFUSIVE MASS TRANSFER

Emphasis on the physical aspects of diffusion; theories of diffusion in dilute gases, dense gases, liquids and solids; surface diffusion; mixing processes. Simultaneous heat and mass transfer. Prereq: Math. 629. 3 cr.

823. ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS

A discussion of the multicomponent open system from the engineering viewpoint; the volumetric and phase behavior of pure substances and of multicomponent systems at physical and chemical equilibrium; fugacity and activity; thermal properties of equilibrium chemically reacting systems; introduction to statistical thermodynamics. 3 cr.

832. ADVANCED CHEMICAL ENGINEERING KINETICS

Discussion of specialized applied kinetics problems; catalysis; fast reaction and shock tubes; combustion and detonation processes; non-isothermal kinetics; heat and mass transfer in non-equilibrium chemically reacting systems. 3 cr.

852. ADVANCED PROCESS DYNAMICS

An advanced treatment of process dynamics including higher order processes and nonlinear processes. Special attention is given to representing a complex process by differential equations, linearizing nonlinear elements, and adequately controlling the entire system. 3 cr.

871. INTRODUCTION TO NUCLEAR ENGINEERING

The scientific and engineering development of nuclear reactors, including basic binding energy physics, nuclear stability, radioactivity, the elements of nuclear reactor theory, and the engineering problems of heat transfer, fluid flow, materials selection, and shielding. This course is intended for any interested graduate students. Prereq: Math. 629. 3 cr.

872. NUCLEAR CHEMICAL TECHNOLOGY

The design, construction, and operation of nuclear process equipment, including reactors and associated chemical processing facilities, and iso-

tope separations plants. The technology of applied radiation chemistry. Intended primarily for graduate students in Chemical Engineering. 3 cr.

897, 898. GRADUATE SEMINAR

Discussion on topics of interest to graduate students and staff; reports of research progress; invited lectures by outside speakers. 0 cr.

899. MASTER'S THESIS

Original investigations in chemical engineering. 1-6 cr.

Chemistry (81)

Alexander R. Amell, *Chairman*

The Department of Chemistry offers programs leading to three graduate degrees: Doctor of Philosophy, Master of Science, and Master of Science for Teachers. Entering graduate students (except for those desiring the M.S.T. degree) are expected to take proficiency examinations in chemistry to assist in starting the new student's graduate work at the proper level. These examinations will be offered at the beginning of the semester in September and in February.

Doctor of Philosophy Degree

Admission to the Ph.D. program is based upon a cumulative undergraduate average of 2.5 and requires satisfactory work in the usual undergraduate courses in general chemistry, analytical chemistry, organic chemistry, and physical chemistry, as well as the normal supporting courses in mathematics and physics. This degree requires the completion of a research problem presented in the form of a thesis.

The Ph.D. candidate will be expected to demonstrate proficiency in reading chemical literature in German and French or Russian. He will also demonstrate to his Doctoral Committee that he has a broad basic knowledge of the field of chemistry: (1) by completing certain fundamental graduate courses, and (2) by means of a series of examinations in his major field. The principal emphasis of the last two years will be on the research project which will constitute the dissertation. During this time the doctoral candidate will present and defend an original research proposal before his Doctoral Committee.

The faculty of the Chemistry Department feels that the experience of teaching is a valuable part of the training of the Ph.D. student. Therefore, all graduate students who are Ph.D. candidates will obtain some teaching experience during their tenure.

Chemical Physics Option

Ph.D. candidates in Chemistry may elect to enter the Chemical Physics program, an interdisciplinary program offered jointly with the Department of Physics. In this option the doctoral student, with the advice of his guidance committee, elects courses in chemistry and physics (or, in some cases, mathematics), writes his dissertation on a research problem (experimental, theoretical, or both) appropriate to interdisciplinary treatment and receives the doctorate in either Chemistry or Physics. In addition, each candidate must satisfy certain other requirements of the department in which the degree is granted. Ordinarily, students choosing the Chemical Physics option are expected to have undergraduate degrees in one of the disciplines Chemistry, Physics or Mathematics and reasonably strong backgrounds in the other two disciplines.

Master of Science Degree

Admission to the M.S. program is based upon a cumulative undergraduate average of 2.5 and requires satisfactory work in the usual undergraduate courses in general chemistry, analytical chemistry, organic chemistry, and physical chemistry, as well as the normal supporting courses in mathematics and physics. This degree requires the completion of a research problem presented in the form of a thesis.

Master of Science for Teachers Degree

The degree of Master of Science for Teachers is offered for candidates who hold a secondary school teacher certification in chemistry. Courses leading to this degree will normally be chosen from Summer Session and Summer Institute offerings and require 30 semester hours in courses approved by the Department Chairman. Persons interested in this degree should confer with him.

Inorganic Chemistry

775. INORGANIC CHEMISTRY

The relationship between chemical reactions and modern concepts of inorganic chemistry on a moderate level. The applicability and limitations of the newer ideas. Mr. Haendler, Mr. Weber. Prereq: Chem. 683-684 or permission of the instructor. 3 cr.

804. ADVANCED INORGANIC CHEMISTRY

A survey from the modern point of view, with emphasis on theoretical and structural concepts. Mr. Haendler, Mr. Weber. Prereq: Chem. 775 or its equivalent. 3 cr.

847. ADVANCED INORGANIC CHEMISTRY

The chemistry of coordination compounds, their ligand field spectra,

magnetic properties, and reaction mechanisms. The metal-ligand bond in crystal field and molecular orbital theories. Prereq: Chem. 804 or permission of instructor. Mr. Haendler, Mr. Weber. 3 cr.

848. ADVANCED INORGANIC CHEMISTRY

The theory and practice of x-ray diffraction and the determination of crystal structure. Mr. Haendler. Prereq: Chem. 804 or permission of instructor. 3 cr.

Analytical Chemistry

661. ANALYTICAL CHEMISTRY

A thorough treatment of the theory and techniques of gravimetric and volumetric analysis followed by special methods of analysis, such as ion exchange and EDTA titrations. Mr. Daggett. Prereq: Chem. 405-406 or equivalent. 3 lec; 2 lab; 5 cr.

762. INSTRUMENTAL ANALYSIS

A treatment of the theory, instrumentation and application of methods such as emission spectrography, flame spectrometry, spectrophotometry, gas chromatography, coulometry, potentiometry, conductometry and polarography to chemical analysis. Mr. Daggett. Prereq: Chem. 661; Chem. 684 a prereq. or concurrent registration, or, permission of instructor. 3 lec; 2 lab; 5 cr. Cannot be used for graduate credit by chemistry students.

830. ADVANCED OPTICAL METHODS

Techniques of chemical identification and analysis utilizing optical instrumentation from the standpoint of both theory and application. Topics include NMR, ESR, X-ray fluorescence, mass spectrometry, electron beam microprobe. Mr. Ellis. 3 cr.

831. ADVANCED ELECTRICAL METHODS

Techniques of chemical identification and analysis utilizing electrical instrumentation from the standpoint of both theory and application. Topics include controlled current coulometry, a-c polarography, chronoamperometry, cyclic voltammetry, controlled potential coulometry. Mr. Daggett. 3 cr.

832. CHEMICAL INSTRUMENTATION

The basic modules of chemical instrumentation, both electrical and optical. Mr. Ellis. 3 cr.

833. CHEMICAL SEPARATIONS

The use of various separation techniques prior to analysis and separations as a method of analysis are discussed. The application of statistics to chemical problems of analysis is covered. Mr. Daggett. 3 cr.

Organic Chemistry

755. ADVANCED ORGANIC CHEMISTRY

The preparation of organic compounds is studied with consideration being given to structural and stereochemical control of the reactions from a knowledge of the mechanism of the reaction. Emphasis is on the solution of assigned problems. Prereq: One year of Organic Chemistry and Physical Chemistry or permission of the instructor. 3 cr.

756. CHARACTERIZATION OF ORGANIC COMPOUNDS

The spectroscopic and chemical properties of organic compounds provide a basis of the systematic characterization of organic structures. Methods for the separation of mixtures of organic compounds are considered. Mr. Lyle. Prereq: One year of Organic Chemistry. 1 lec; 2 labs; 3 cr.

801. THEORETICAL ORGANIC CHEMISTRY

The structural theories of organic chemistry including valence bond and molecular orbital theories. Emphasis on stereochemistry, including conformational analysis, and aromaticity. 3 cr.

802. THEORETICAL ORGANIC CHEMISTRY

A course in the mechanistic concepts of organic chemistry including discussions of theoretical and experimental methods used in the study of reaction mechanisms. 3 cr.

807, 808. INTRODUCTION TO RESEARCH TECHNIQUES

Lectures and laboratory to show experimental methods and interpretation of results. Topics include spectroscopy, electrochemistry, separation methods, and others. Staff. 1-6 cr.

811. SYNTHETIC ORGANIC CHEMISTRY

Advanced discussion of heterolytic and homolytic substitution and elimination reactions of the major classes of organic compounds, with emphasis on the synthetic utility of these reactions. By permission of the instructor. 3 cr.

812. SYNTHETIC ORGANIC CHEMISTRY

Addition, oxidation and reduction reactions and selected molecular rearrangements, with emphasis on the synthetic applications of these reactions. The synthesis and structure determination of complex organic compounds. By permission of the instructor. 3 cr.

817, 818. SPECIAL TOPICS IN ORGANIC CHEMISTRY

Specialized courses for the advanced student. Topics may include reaction mechanisms, stereochemistry, spectroscopy, molecular biochemistry, steroids, alkaloids, organic sulfur compounds, and nitrogen heterocycles. Mr. Lyle, Mr. Jones, Mrs. Lyle, Mr. Andersen, Mr. Uebel and Mr. Morrison. 2 or 3 cr.

Physical Chemistry

663. INTRODUCTORY RADIOCHEMICAL TECHNIQUES

Radiochemical techniques and laboratory practice in the use of apparatus in many fields of science which utilizes radiochemical operations. Prereq: General inorganic chemistry and general physics. Mr. Amell or Mr. Owens. 3 lec; 2 lab; 5 cr.

683-684. ELEMENTARY PHYSICAL CHEMISTRY

The properties of gases, liquids, and solids; thermochemistry and thermodynamics; solutions, chemical equilibria, reaction rates, conductance and electromotive force. Prereq: Math. 523 or 426 and Physics. Undergraduates must register for Chem. 685-686 concurrently. 3 lec; 3 cr.

685-686. PHYSICAL CHEMISTRY LABORATORY

Experimental work illustrating the principles of chemistry. Emphasis is upon the measurement of thermodynamic properties, chemical kinetics and methods of determining the structure of matter. Prereq: Math. 523 or 426 and Physics. Must be taken concurrently with Chem. 683-684. 2 lab; 2 cr.

776. ADVANCED PHYSICAL CHEMISTRY

Foundations of Quantum Theory, Elementary Quantum Mechanics, Theory of Spectra, Statistical Thermodynamics. Prereq: Chem. 683-684. 3 cr.

805, 806. ADVANCED PHYSICAL CHEMISTRY

Wave mechanics and quantum chemistry, spectroscopy, molecular structure; statistical thermodynamics, kinetics and mechanism. Prereq: One year of physical chemistry. 3 cr.

821. PHYSICAL CHEMISTRY — CHEMICAL KINETICS

The kinetics of homogeneous and heterogeneous reactions in gaseous and liquid systems, including an introduction to photochemistry. Mr. Amell or Mr. Owens. Prereq: One year of physical chemistry. 3 cr.

822. PHYSICAL CHEMISTRY — CHEMICAL THERMODYNAMICS

The foundations and inter-relationships of the theory of thermodynamics. The methods by which the theoretical principles may be applied to practical problems. Mr. Wheeler. 3 cr.

826. NUCLEAR AND RADIOCHEMISTRY

Nuclear structure and reactions, particle accelerators, radioactive decay, detection of particles, and the interaction of particles with matter. Application of radiochemistry to chemical systems and research. Mr. Amell or Mr. Owens. 3 cr.

827, 828. THEORETICAL CHEMISTRY I, II

The modern concepts and mathematical formalism of quantum mechanics with applications to electronic structures of atoms and molecules, spectroscopy, and the solid state. Mr. Pilar. 3 cr.

Chemistry

829. THEORETICAL CHEMISTRY III

Statistical mechanics with applications to thermodynamics of non-ideal systems, intermolecular forces, and chemical kinetics. Permission of the instructor. Mr. Pilar. 3 cr.

895, 896. COLLOQUIUM IN CHEMISTRY

- a. INORGANIC CHEMISTRY, Mr. Haendler, Mr. Weber
- b. ORGANIC CHEMISTRY, Mr. Andersen
- c. ORGANIC CHEMISTRY, Mrs. Lyle
- d. THEORETICAL ORGANIC CHEMISTRY, Mr. Uebel
- e. ORGANIC CHEMISTRY, Mr. Morrison
- f. PHYSICAL CHEMISTRY, Mr. Amell, Mr. Owens
- g. PHYSICAL CHEMISTRY, Mr. Pilar, Mr. Berney
- h. PHYSICAL CHEMISTRY, Mr. Wheeler
- i. ANALYTICAL AND PHYSICAL CHEMISTRY, Mr. Daggett
- j. ORGANIC CHEMISTRY, Mr. Jones
- k. ORGANIC CHEMISTRY, Mr. Lyle
- l. ANALYTICAL CHEMISTRY, Mr. Ellis

3 cr. Sections of the course may be taken to a total of 12 cr.

897, 898. SEMINAR

Presentation and discussion of recent investigations in chemistry. 1 cr.

899. THESIS — PROBLEMS IN CHEMISTRY

Conferences, library, and experimental work in some field of chemistry. Staff. Credits to be arranged.

999. DOCTORAL RESEARCH

Courses for the M.S.T. Degree

The following courses usually are offered only in the Summer Session.

781. THE TEACHING OF HIGH SCHOOL CHEMISTRY

Present day subject matter in general chemistry; choice of experiments for laboratory and lecture demonstrations; and presentation and evaluation of teaching methods which are effective in stimulating students. 4 cr.

782. MODERN INORGANIC CHEMISTRY FOR THE HIGH SCHOOL TEACHER

The current concepts on such topics as fundamental particles, atomic structure, nuclear reactions, electronic configurations and orbitals, chemical bonds, the periodic table, oxidation-reduction, acids and bases, energy relationships, and ionic reactions. Prereq: Freshman Chemistry. 4 cr.

783. ANALYTICAL CHEMISTRY FOR HIGH SCHOOL TEACHERS

The principles of ionic equilibria in qualitative and quantitative analysis. Experimental work in qualitative analysis using the semimicro technique. The experimental work in quantitative analysis acquaints the

student with the principles, techniques, and calculations of gravimetric and volumetric determinations. Some experimental work involves the use of the spectrophotometer in quantitative analysis and the glass electrode method of measurement of pH. 8 cr.

784. MODERN APPROACH TO ORGANIC CHEMISTRY FOR HIGH SCHOOL TEACHERS

The structure and properties of organic compounds, including those of current interest and importance, such as natural and synthetic polymers, antibiotics, and medicinals. An understanding of the behavior of organic compounds will be based on current theories of reactions. Prereq: General chemistry. 8 cr.

785. PHYSICAL CHEMISTRY FOR HIGH SCHOOL TEACHERS

The laws of chemistry and their application to physical and chemical changes. Prereq: College physics, algebra and trigonometry. 8 cr.

786. RADIOCHEMISTRY FOR HIGH SCHOOL TEACHERS

The theory of radioactive decay, the effects of radioactive decay upon matter, and the methods and techniques of the detection of radioactive decay. The uses of radiotracers in research. Prereq: General chemistry and general physics. 4 cr.

787. LABORATORY TECHNIQUES IN CHEMISTRY

Modern methods for the separation, identification, and estimation of substances. Experiments will be designed to assist the teacher by providing new subjects for laboratory demonstrations and student projects. Prereq: Analytical and organic chemistry. 4 cr.

788. ADVANCED ORGANIC CHEMISTRY FOR HIGH SCHOOL TEACHERS

Types of homolytic and heterolytic reactions of organic compounds and their relationship to organic structures, including configuration and conformation. Prereq: Chem. 794 or its equivalent. 4 cr.

789. ATOMIC AND MOLECULAR STRUCTURE

The methods of determining atomic and molecular structure, including ultraviolet and infrared spectroscopy and radiochemistry. 4 cr.

Civil Engineering (82)

J. Harold Zoller, *Chairman*

A candidate for the degree of Master of Science in Civil Engineering must have completed a course of study equivalent to that required by this department for the baccalaureate degree or he must take specified courses in the areas of deficiency without credit. An oral final examination is required of all candidates.

Civil Engineering

A candidate for the Master's degree will normally complete a thesis for not less than 6 nor more than 9 hours of credit. With the permission of the department, a student may be permitted to substitute approved course work for the thesis requirement. In this event he must also submit to his examining committee a paper written in one of his courses, which shall be the equivalent of a thesis in style and quality, but not in scope. One copy of the thesis or paper is required by the department.

Courses numbered between 600 and 699 may be taken for graduate credit by non-majors only.

Courses numbered above 700 may be offered biennially or upon demand.

Permission of the instructor and consent of the student's adviser are required for enrollment in all Civil Engineering courses.

620. TRANSPORTATION ENGINEERING

The development, organization, administration, and inter-relation of transportation systems and facilities, including railroads, highways, airports, waterways, and pipe lines. Major emphasis will be given to the economics of location, geometric and structural design, construction materials, methods, and costs, as applied to modern transportation engineering. Prereq: C.E. 506. 3 lec; 3 cr.

643. WATER SUPPLY AND TREATMENT

The sources, quantity, quality, and sanitary aspects of public water supplies. Methods of purification and distribution systems. Mr. Langley. 3 lec; 1 lab; 4 cr.

644. SEWERAGE AND SEWAGE TREATMENT

The theory and problems of sewerage, the principles governing the disposal of sewage, and the various methods of sewage treatment. Mr. Langley. Prereq: C.E. 643. 3 lec; 1 lab; 4 cr.

665. SOIL MECHANICS

Soil classification, physical properties including permeability, compressibility, bearing capacity, settlement, and shear resistance are related to the principles underlying the behavior of soils subjected to various loading conditions. Underground exploration and typical foundation problems are included. 3 lec; 1 lab; 4 cr.

711. COMMUNITY PLANNING

Social, economic, and physical factors; content and extent of desirable programs, including purpose and scope, the preliminary survey, elements of community land planning, the master plan, transportation systems, street patterns and traffic, motor vehicle parking, airport sites, public building sites, parks and recreational facilities, zoning, control of land sub-division, neighborhood centers, housing, legal, financial and economic problems, and redevelopment of blighted areas. Mr. Dawson. 3 cr.

714. CONTRACTS, SPECIFICATIONS, AND PROFESSIONAL RELATIONS

The essential elements required in engineering contracts; the purposes and content of specifications; professional conduct, relations, and ethics; and estimating by means of quantity surveys and unit cost methods. Mr. Dawson. 3 cr.

721. HIGHWAY ENGINEERING I

Highway organization, administration, finance, planning, programming, traffic surveys, traffic methods; highway laws, contracts, specifications; highway capacity, geometric design, access control, safety, accident studies; pavement performance and evaluation. Mr. Sanborn. Prereq: C.E. 620. 3 lec; 3 cr.

722. HIGHWAY ENGINEERING II

Design of flexible and rigid pavements and bases for highways, airports, and city streets; soil exploration, pavement selection, construction methods, materials, specifications, and engineering cost estimates. Mr. Sanborn. Prereq: C.E. 620, C.E. 665. 3 lec; 3 cr.

741. HYDRAULIC ENGINEERING

Application of fluid mechanics to hydraulics problems, such as reservoirs, dams, control works, open-channel flow, hydro-electric power, irrigation, drainage, and multi-purpose projects. Mr. Langley and Mr. Zoller. Pre-req: C.E. 642. 2 lec; 1 lab; 3 cr.

742. HYDROLOGY

The occurrence and physical effects of water on the earth, including meterology, groundwater runoff, and streamflow routing. Mr. Langley. Prereq: C.E. 642 concurrently or as a prerequisite. 2 lec; 1 lab; 3 cr.

782. WOOD STRUCTURES

Properties and characteristics of structural woods, connection methods, design of timber members and connections in beams, columns, and trusses, and glued laminates of wood. Prereq: C.E. 692. 1 lec; 1 design period; 2 cr.

784. TOPICS IN STRUCTURAL ENGINEERING

Presentation of a unifying concept of basic structural theories; introduction to matrix and numerical methods of analysis; introduction to beams on elastic foundations. Prereq: C.E. 685. 3 lec; 3 cr.

790. LIMIT DESIGN

Introduction to modern design theories; ultimate design of reinforced concrete and plastic analysis of steel structures. Prereq: C.E. 685 and C.E. 693. 2 lec; 1 design period; 3 cr.

841-842. ADVANCED HYDRAULICS

Sediment transportation, secondary flows, design of hydraulic structures,

Civil Engineering

reservoir and channel routing techniques, basic hydrodynamics and independent study. Mr. Zoller and Mr. Langley. 3 cr.

843-844. EXPERIMENTAL HYDRAULICS

Experimental techniques and laboratory practice. Experimental studies of the fundamental phenomena of liquid flow. Mr. Dawson. Prereq: C.E. 642. 3 cr.

855-856. ADVANCED HYDRAULIC AND SANITARY ENGINEERING

Hydrology, hydraulics of river flow, flood flows, design of reservoirs, flood control, river control, and hydraulic and sanitary structures. Water treatment and sewage treatment practices. Mr. Langley. Prereq: C.E. 643 and 644. 3 cr.

863-864. SOIL MECHANICS

The physical and mechanical properties of soil in relation to engineering structures. The theory of consolidation, shearing resistance, bearing capacity, settlement, earth pressure, and seepage studies. Prereq: C.E. 665. 3 cr.

865. SOIL TESTING FOR ENGINEERING PURPOSES

The essential tests for the physical properties: permeability, capillarity, compressibility, rate and magnitude of consolidation, and shearing resistance. 2 to 4 cr.

866. FOUNDATION ENGINEERING

Application of the principles of soil mechanics to selection of type of substructure, foundation construction methods, exploratory soil studies, stability analysis, earth dam and tunnel construction, and underpinning operations. Prereq: C.E. 665. 3 cr.

881. ADVANCED STRUCTURAL ANALYSIS I

Unifying network concepts of structural analysis. Advanced structural theory and analysis including multi-story structures, beam-columns, frames with variable moment of inertia, continuous trusses and bents, and influence lines. Mr. Wang. Prereq: C.E. 790. 3 cr.

882. ADVANCED STRUCTURAL ANALYSIS II

Advanced analysis including arches and curved frames, space frames, rings and closed frames, shear flow and flexual stresses in thin walled sections, suspension bridges, folded plates, and introduction to structural dynamics. Mr. Wang. Prereq: C.E. 881. 3 cr.

883. ADVANCED STRUCTURAL DESIGN

Ultimate strength design in reinforced concrete. Prestressed concrete design. Plastic design of steel structures. Mr. Wang. Prereq: C.E. 685. 3 cr.

895, 896. CIVIL ENGINEERING PROBLEMS

The study and investigations of problems selected to meet the needs of the student. 2 or 3 cr.

899. MASTER'S THESIS

Hours and credits, from 6 to 9, to be arranged.

Economics (72)

Robert F. Barlow, *Dean*

Whittemore School of Business and Economics

Admission to graduate study in Economics leading to the degree of Master of Arts is limited to students with a better than average undergraduate record. Candidates for admission are required to take the Graduate Record Examination (both the Aptitude Test and Advanced Test in Economics). The prerequisite for graduate work consists of a minimum of 24 hours of undergraduate study in Economics and related fields of which at least 12 hours shall have been in Economics. In addition, all candidates must either present six hours of undergraduate credit in statistics or mathematics, or take six hours of undergraduate work in statistics or mathematics at the University of New Hampshire without credit, or pass a proficiency test in either field.

The candidate for a Master's degree must fulfill the general requirements of the Graduate School and the following major requirements:

1. Thirty semester hours of graduate study or 24 semester hours and a thesis:

(a) a minimum of 21 semester hours in courses numbered 700 and above, of which 6 hours may be satisfied by an acceptable thesis; at least 9 of these hours, exclusive of the thesis, must be in courses numbered 800 and above; (If a thesis is to be submitted, it must be in form for presentation to the Reading Committee by May 1 of the year in which the degree is to be granted.)

(b) a maximum of 9 semester hours in approved courses numbered 600 and above in related disciplines.

2. A course grade of B or better at the graduate level as evidence of proficiency in both micro- and macro- economic analysis.

3. Evidence of proficiency, based upon a written examination, in one of the following major areas:

- (a) Quantitative Methods
 - (b) Labor Economics and Industrial Relations
 - (c) Public Policy Toward Business and Labor
 - (d) Economic Growth and Stability
 - (e) International Economy and Economic Development
 - (f) Resource Development
 - (g) Economic History and the History of Economic Thought
-

Economics

704, 705. ECONOMIC HISTORY I AND II

An analysis of the growth of the American and European economies.
3 cr.

725. BUSINESS HISTORY

A survey of the development of business enterprise and its institutions in Western Europe and the United States from the late Middle Ages to the era of the giant diversified corporation. Emphasis is placed on the role of the entrepreneur, the impact of public policy on business and the case study of individual firms. Mr. Greenleaf. 3 cr. (This course is the same as B.A. 725 and Hist. 725.)

727. PUBLIC POLICY IN SOCIAL AND LABOR LEGISLATION

This course will cover American social and labor legislation of the recent decades and provide an opportunity to study the way in which American economic and human values have been implemented and modified by law. Attention will be given to legislation and private industry programs in social security, reemployment, unemployment insurance, health services, training and retraining and fair employment practice. The course will include lectures discussion, assigned reading and individual student projects. Mr. McConnell. 3 cr. (This course is the same as Sociology 727).

754. ADVANCED MONEY AND BANKING

Emphasis on central banking, monetary policy and monetary theory. Study of current problems and developments in banking. Mr. Degler. 3 cr.

774. MATHEMATICAL ECONOMICS

An introduction to the principal mathematical techniques and their application in economics. Mr. Braff. Prereq: Permission of the instructor. 3 cr.

776. ECONOMIC FLUCTUATIONS

The study of recurrent movements of prosperity and depression, with emphasis upon causes and public policy implications. Mr. Rosen. Prereq: Econ. 675 or permission of the instructor. 3 cr.

781. ADVANCED STATISTICS

The theoretical basis of statistical methods, probability, probability distributions, statistical inference, and decisions. Mr. Cole. Prereq: Permission of the instructor. 3 cr.

782. ECONOMETRICS

The application of statistics and mathematics to economic problems. The formulation of economic models, their measurement and verification. Mr. Cole. Prereq: Permission of the instructor. 3 cr.

784. STATISTICAL DECISION MAKING

The application of probability and statistics to decision problems. Special emphasis on the Bayesian approach to decisions under uncertainty. Mr. Braff. Prereq: Permission of the instructor. 3 cr.

851. HUMAN RELATIONS IN INDUSTRY

Labor-management relations studied as one aspect of human relations; applications of recent research in the behavioral sciences; case studies. Mr. Hogan. 3 cr.

852. ECONOMICS OF COLLECTIVE BARGAINING

Tools of economic analysis applied to collective bargaining — wages, productivity, seniority rules, job security, package bargaining. Application to cases. Mr. Hogan. 3 cr.

857-858. HISTORY OF ECONOMIC THOUGHT

The evolution of economic thought. Examination and critical appraisal of the work of major economists and major schools of economists, particularly with reference to the applicability of their theories to current economic problems. Mr. Bowring. 3 cr.

859. GOVERNMENT REGULATION OF BUSINESS

Analysis of government policy with reference to such problems as conspiracy, monopoly, mergers, unfair practices, and discrimination. This analysis includes a legal and economic appraisal of government policy alternatives. Mr. Irwin. 3 cr.

861. ECONOMIC SYSTEMS

Analysis of the functioning of various types of national economic systems. Emphasis on economic planning and development. Mr. Donovan. 3 cr.

863. INTERNATIONAL ECONOMICS

A survey of contemporary issues in international economic theory and policy. Analysis of trade theory, balance of payments problems, international liquidity, and the adjustment processes. Mr. Rothwell. 3 cr.

873. MACROECONOMIC THEORY

Emphasis on national income theory, its development, and policy implications. Mr. Rosen. 3 cr.

878. MICROECONOMIC THEORY

Topics in micro-economics with emphasis on recent developments in such areas as general equilibrium analysis, welfare economics, demand theory, and capital theory. Mr. Braff. 3 cr.

891. SEMINAR IN MONETARY THEORY AND POLICY

Contemporary developments in monetary theory and the evaluation of policy measures. Mr. Wrightsman. 3 cr.

Economics

892. SEMINAR IN PUBLIC FINANCE — THEORY AND POLICY

Selected topics in contemporary theoretical and policy problems of public finance. Mr. Schulz. 3 cr.

894. SEMINAR IN ECONOMIC DEVELOPMENT

A survey of theories and detailed case studies in problems of economic development. Mr. Chough. 3 cr.

895-896. INDEPENDENT STUDY

Selected projects. Staff. 6 cr.

899. THESIS

Staff. 6 cr.

Education (48)

Roland B. Kimball, *Chairman*

Admission to Graduate Standing

Admission to graduate standing in the Department of Education is granted to applicants meeting the entrance requirements of the Graduate School and accepted by the Department. Applications must include Graduate Record Examination scores for both the aptitude test and the achievement test in the field selected by the applicant.

The Department offers courses leading to the Master of Education degree and to the Master of Arts in Teaching degree.

Master of Education

Master of Education programs are offered in the following areas of specialization:

Elementary Education

Secondary Education

Counseling and Personnel Services

Reading

Administration and Supervision

School Library Science

Teaching the Deaf

Specific requirements for completion of the programs vary with the area of specialization. For further information please write to the chairman of the department.

Thesis or Comprehensive Examination

Candidates in the Master of Education program ordinarily will be expected to complete a research thesis, or a comprehensive examination,

which may be written or oral. Each candidate will plan this portion of his program in terms of his own professional situation and in consultation with his graduate adviser.

There is no thesis or examination requirement for the Master of Arts in Teaching.

Master of Arts in Teaching

The Master of Arts in Teaching program is designed for candidates who have completed an undergraduate degree with a strong academic major but have not followed a program of professional preparation for teaching. The Master of Arts in Teaching program will provide a balanced curriculum in teacher preparation with heavy emphasis on a supervised internship in teaching and an opportunity to complete further graduate work in the academic subjects most closely related to the candidate's teaching field.

Candidates will spend two summers and the intervening academic year in graduate study. The first summer will provide an opportunity to study and practice educational methods under the supervision of master teachers in the University's summer high school. During the academic year the student will be placed in a local school system as a teaching intern with a half time load. Interns will be paid by the local school system, according to the policy of the local school board. Concurrently the intern will attend seminars on campus which will extend his grasp of educational theory and method and will relate these studies to the experiences the intern encounters as a teacher in a school system. The final summer will complete the courses included in the program.

In 1967-1968 the Master of Arts in Teaching programs will be open to prospective secondary and elementary school teachers of English, mathematics, sciences, social studies, and foreign languages. For further information please write to the Director, Master of Arts in Teaching, Department of Education.

Certificate of Advanced Graduate Study

There is a post-master's degree program in counselor education leading to a Certificate of Advanced Graduate Study. Applicants for admission to this program must meet the entrance requirements described on page 19. For further information please write to Professor Angelo V. Boy, Department of Education.

733. TEACHING THE LANGUAGE ARTS

Comparison of current schools of thought with regard to language arts instruction. Discussion of procedures, materials and diagnostic and evaluative techniques. Emphasis on improving oral expression, functional and creative writing, literature and spelling. Correlation of language arts with other areas of the curriculum. 3 cr.

Education

734. CHILDREN'S LITERATURE

The consideration of children's books and methods of using them. Lectures and the opportunity to examine and evaluate a wide variety of books for children of all ages, with emphasis on the intermediate grades. Practical demonstrations of how to correlate children's books with various special subjects. 3 cr.

735. THE TEACHING OF ELEMENTARY SCHOOL FOREIGN LANGUAGES

Methods and materials for the audio-lingual teaching of foreign languages in the elementary school. 3 cr.

736. THE TEACHING OF ELEMENTARY SCHOOL SOCIAL STUDIES

Designed to help elementary teachers develop a social-studies program. It includes a study of the methods and materials which seem to be most effective in this field. The psychological development of children of different ages. 3 cr.

737. THE TEACHING OF ELEMENTARY SCHOOL MATHEMATICS

Formation of number concepts and the development of arithmetic skills. Modern methods of teaching arithmetic are demonstrated. Prereq: Teaching experience. 3 cr.

739. THE TEACHING OF ELEMENTARY SCHOOL SCIENCE

Emphasis is placed on the learning process and the instructional techniques necessary for teaching the major concepts from science. 3 cr.

745. ELEMENTARY SCHOOL CURRICULUM REORGANIZATION

The theories and procedures of curriculum development in the elementary school. Prereq: Teaching experience. 3 cr.

753. TEACHING EXCEPTIONAL CHILDREN

A consideration of the organization, materials, and methods suitable for the instruction of atypical children. Emphasis will be given to the teaching of creative children. Use of prose, poetry, creative dramatics, and similar teaching techniques. 3 cr.

757. PSYCHOLOGY OF HUMAN LEARNING

Psychology of learning as it operates within the classroom. Prereq: Ed. 481 and permission of the department. 3 cr.

758. PRINCIPLES OF TEACHING

Application of the theories of learning studied in Ed. 757, with emphasis upon the following: organization of content, specific planning, and a study of procedures essential to the evaluation of the learning processes. Prereq: Ed. 757 and permission of department. Two 2-hour rec-labs; 3 cr.

759. PRINCIPLES OF EDUCATION

American schools have developed, and are still developing, in unique forms quite unlike their European counterparts. Among Americans, however, there are basic disagreements concerning the direction our schools

should take. This course deals with these conflicts of philosophy, the problems of American education, and research pertinent to these problems. Prereq: Ed. 757 and permission of Department. 3 cr.

763. INSTRUCTIONAL MEDIA

To help improve ability to communicate ideas through materials and equipment commonly available in a school audio-visual center. Educational films, bulletin board design, the role of language labs, educational television, programmed learning, and media research. A laboratory period of one hour each week is required in addition to the regular class period. Prereq: Ed. 757 or permission of instructor. 3 cr.

785. EDUCATIONAL TESTS AND MEASUREMENTS

An introduction to the theory and practice of educational evaluation. Emphasis given to use of test results in classroom teaching and student counseling. Analysis of standardized tests in terms of (a) their psychological, or factorial, meanings and (b) their practical, or predictive, uses. Prereq: Ed. 757. 3 cr.

787. PRINCIPLES OF ELEMENTARY EDUCATION

The underlying principles of education as applied to the teaching of children in elementary schools will be coordinated with the fundamentals of educational psychology and translated in terms of methods of teaching. Adaptations of various methods and plans as carried on in modern elementary schools. 3 cr.

807. IMPROVEMENT OF READING

Comparison of current schools of thought with regard to reading instruction. Discussion of procedures, materials, and diagnostic and evaluative techniques. Emphasis on small group and individual activities to assure the mastery of basic reading abilities. The use of reading in school and leisure situations. Prereq: Teaching experience. 3 cr.

808. DIAGNOSTIC AND REMEDIAL PROCEDURES IN READING

A study of the techniques of analysis and correction or prevention of problems in reading, spelling and language. Discussion and demonstration of diagnostic tests and remedial methods. Practice in clinical analysis, techniques of work with individuals, teams, small groups and classes. Prereq: Educ. 807. 3 cr.

809. READING CLINIC

Practicum in improvement of reading including direct experience with children having reading difficulties. Seminars will consider individual cases and remedial procedures. 3 cr. Prereq: Educ. 808 (may be taken concurrently) and permission of instructor required by June 1.

815. HISTORY, EDUCATION, AND GUIDANCE OF THE DEAF

A consideration of the place of the deaf in the community. Social, politi-

Education

cal, and psychological viewpoints are examined. Review of studies relevant to learning problems and social adjustment of the deaf. Prereq: Ed. 759. 3 cr.

816. TEACHING LANGUAGE TO THE DEAF

Principles and techniques of teaching language to the pre-school and school-age deaf child. Prereq: Ed. 733. 3 cr.

819. SPEECH READING AND AUDITORY TRAINING

Principles, techniques, and materials for teaching speech reading to the hard-of-hearing and deaf individual. Classical speech reading procedures surveyed. Emphasis given to the combined approach of speech reading, auditory training and speech/language development. Prereq: Speech and Drama 521, 524 or approval of instructor. 3 cr. (Also offered as Speech and Drama 706.)

820. TEACHING SPEECH TO THE DEAF

Methods for developing speech patterns of the pre-school and school-age deaf child. Correction of speech defects. Prereq: Permission of instructor. 3 cr.

825. AUDIOLOGY

Attributes of sound and the mechanism of hearing as they pertain to classical study of science of audiology. Elementary physics of sound and the decible; anatomy of the aural mechanism; essentials of hearing theory; pathologies of the auditory and related systems; basic pure tone audiometry technique. Prereq: Approval of instructor. 3 cr. (Also offered as Speech and Drama 704.)

826. OBSERVATION AND PRACTICUM IN EDUCATION OF THE DEAF

Observation and analysis of various programs for education of the deaf. Supervised internship in teaching the deaf. Prereq: Permission of the instructor. 3-6 cr.

827. TEACHING ELEMENTARY SCHOOL SUBJECTS TO THE DEAF

Methods of teaching science, social studies, reading, and language arts to the deaf child. Offered concurrently with a supervised internship. Prereq: Concurrent internship. 4 cr.

830. PSYCHOLOGY AND EDUCATION OF EXCEPTIONAL CHILDREN

A survey of psychological problems of handicapped children and a consideration of the implications for educational practice. Prereq: Ed. 757. 3 cr.

831. SEMINAR AND PRACTICUM FOR MASTER OF ARTS IN TEACHING (ELEMENTARY SCHOOL).

Practicum and related seminars as follows: (a) SEMINAR IN EDUCATIONAL PSYCHOLOGY. Developmental psychology covering the period from early childhood through adolescence. Specific attention given to applications

of psychological theory to classroom practice. (b) SEMINAR IN EDUCATIONAL METHODOLOGY. A study of the elementary school curriculum and methods of instruction in reading and elementary mathematics. This seminar will be directly related to experience of candidate in the Practicum. (c) PRACTICUM. Observation of master teachers in reading and elementary mathematics assigned to the University Summer Elementary School. Opportunities to teach elementary school children under the supervision of the master teachers. *Offered Summers only.* Prereq: Admission to the Master of Arts in Teaching program. 9 cr.

832. INTERNSHIP AND SEMINAR FOR MASTER OF ARTS IN TEACHING (ELEMENTARY SCHOOL)

Internship and related seminars as follows: (a) SEMINAR IN EDUCATIONAL PSYCHOLOGY. Advanced study in developmental psychology and systematic study of cognitive psychology. Specific attention given to applications of theory in solving problems of classroom instruction encountered in the internship. (b) SEMINAR IN EDUCATIONAL METHODOLOGY. A study of the elementary school curriculum and methods of instruction in elementary school science, social science, music, art, and physical education. This seminar will be directly related to planning instruction offered by the student as an intern teacher. (c) INTERNSHIP. Half-time elementary school teaching under the supervision of the University faculty. *Offered first semester only.* Prereq: Education 831. 6 cr.

833. INTERNSHIP AND SEMINAR FOR MASTER OF ARTS IN TEACHING (ELEMENTARY SCHOOL)

Internship and related seminars as follows: (a) SEMINAR IN HISTORICAL AND SOCIAL FOUNDATIONS OF EDUCATION. A study of the history of public education in the United States and the contemporary social conditions which influence public education today. (b) SEMINAR IN EDUCATIONAL METHODOLOGY. A continuation of the seminar started in Education 832. (c) INTERNSHIP. Half-time elementary school teaching under the supervision of the University faculty. *Offered second semester only.* Prereq: Ed. 832. 6 cr.

835. SEMINAR AND PRACTICUM FOR MASTER OF ARTS IN TEACHING. (SECONDARY SCHOOL)

Practicum and related seminars as follows: (a) SEMINAR IN EDUCATIONAL PSYCHOLOGY. Developmental psychology covering the period from early childhood through adolescence. Specific attention given to application of psychological theory to classroom practice. (b) SEMINAR IN EDUCATIONAL METHODOLOGY. A study of the secondary school curriculum and general methods of instruction. Candidates will make a detailed study of the secondary school curriculum and special methods of instruction in their own specific teaching field. (c) PRACTICUM. Candidates are assigned to a

Education

master teacher in their specific teaching field for observation in the University Summer High School. There will be opportunities for candidates to do supervised teaching in their subject field. *Offered summers only.* Prereq: Admission to the Master of Arts in Teaching Program. 9 cr.

836. INTERNSHIP AND SEMINAR FOR MASTER OF ARTS IN TEACHING (SECONDARY SCHOOL)

Internship and related seminars as follows: (a) **SEMINAR IN EDUCATIONAL PSYCHOLOGY.** A systematic study of cognitive psychology. Specific attention given to applications of theory in solving problems of classroom instruction encountered in the internship. (b) **SEMINAR IN EDUCATIONAL METHODOLOGY.** A continuation of the special methods seminar started in Education 835. Candidates elect the seminar which provides a detailed study of the secondary school curriculum and special methods of instruction in their own specific teaching field. This seminar will be directly related to planning instruction offered by the candidate as an intern teacher. (c) **INTERNSHIP.** Half-time secondary school teaching in the candidate's major field under the supervision of the University faculty. *Offered first semester only.* Prereq: Ed. 835. 6 cr.

837. INTERNSHIP AND SEMINAR FOR MASTER OF ARTS IN TEACHING (SECONDARY SCHOOL)

Internship and related seminar as follows: (a) **SEMINAR IN HISTORICAL AND SOCIAL FOUNDATIONS OF EDUCATION.** A study of the history of public education in the United States and the contemporary social conditions which influence public education today. (b) **INTERNSHIP.** Half-time secondary school teaching in the candidate's major field under the supervision of the University faculty. *Offered second semester only.* Prereq: Ed. 836. 3 cr.

842. LIBRARY ORGANIZATION AND SERVICE

Background and development of the school library, including philosophy, functions, objectives and standards. Problems of organization and administration. Relationship to curriculum, teacher, and students, and the public library. 3 cr.

843. BASIC REFERENCE AND INFORMATIONAL SERVICES FOR THE SCHOOL LIBRARY

The selection and evaluation of basic reference materials common to all libraries with special application to the school. Familiarity with informational and research tools and intensive practice in their use. 3 cr.

844-845. TECHNICAL PROCESSES IN THE SCHOOL LIBRARY

Organizing materials with special emphasis on classification and cataloguing systems. Practice in the technical arrangement of books, pamphlets, periodicals, recordings, and pictures. Ordering, processing, mending, and binding procedures. 6 cr.

846. SELECTION AND ACQUISITION OF BOOKS AND OTHER MATERIALS

Techniques for building the library collection in all subject areas. A wide range of sources, aids, and tools are considered. Intensive reading and analysis of books for children and young people. Practice in the compilation of bibliographies for special levels and interests, and in relating selection to curriculum needs. Prereq: Ed. 842 and Ed. 843. 3 cr.

847. READING GUIDANCE

The role of the school librarian in reading growth and development through the promotion of interest and skills in reading. Review of current research and studies on reading and reading habits, the mass media, reading disabilities, and other factors that retard or promote the use of printed materials. Prereq: Ed. 842 and Ed. 843. 3 cr.

848. DIRECTED RESEARCH IN SCHOOL LIBRARIANSHIP

Prereq: Ed. 846 and Ed. 847 (may be taken concurrently). 2-4 cr.

850. ADMINISTRATION OF INSTRUCTIONAL MATERIALS PROGRAMS

To help public school audio-visual personnel examine the planning, organizing, and communicating activities that provide a foundation for the effective use of newer educational media. Selection, evaluation, in-service training, planning new facilities, a current research and systems design. A previous course in audio-visual education is desirable. Prereq: Permission of the instructor. 3 cr.

851. PROGRAMMED INSTRUCTION

Examination of the advantages and limitations of programmed instruction and of its psychological foundation. The various types of teaching machines, the results of experimentation with programmed instruction, and the method of developing programmed instruction material. Prereq: Ed. 757. 3 cr.

852. PRINCIPLES AND PROBLEMS OF SECONDARY-SCHOOL CURRICULUM REORGANIZATION

Significant changes in secondary-school offerings, with emphasis on curriculum revision and techniques of revision. Prereq: Teaching experience. 3 cr.

853. SEMINAR IN CURRICULUM STUDY

The techniques and procedures of curriculum development for the purpose of better meeting the educational needs of adolescents. Prereq: Teaching experience. 3 cr.

855. ADVANCED HUMAN DEVELOPMENT

A critical examination of the social, psychological, and educational aspects of human development with special emphasis on the role of the school. Prereq: Ed. 481. 3 cr.

Education

858. ADVANCED PRINCIPLES OF TEACHING

An opportunity to study problems, principles, and teachings which are involved in planning for pupil learning. Prereq: Teaching experience. 3 cr.

861. PUBLIC SCHOOL ADMINISTRATION

For students who have had teaching or administrative experience, and are looking forward to further work as superintendent, principal, or departmental head. Emphasis on policy-making, management, personnel, public relations, finances, housing, curricula, reporting, and research. Prereq: Teaching experience. 3 cr.

862. EDUCATIONAL FINANCE AND BUSINESS MANAGEMENT

Aspects and principles of financing education, budgetary procedure, accounting, auditing, school indebtedness, financial reporting and business management. Experience in handling practical school finance problems will be part of the project work. Prereq: Ed. 861. 3 cr.

863. SEMINAR IN EDUCATIONAL ADMINISTRATION

A study of cases and concepts in educational administration. Prereq: Ed. 861. 3 cr.

864. PRACTICUM IN EDUCATIONAL ADMINISTRATION

Supervised practical experience in dealing with problems in educational administration. Prereq: Ed. 862. 3 cr.

865. EDUCATIONAL SUPERVISION

Theoretical foundations of supervisory behavior as a means of effecting changes in instructional practices; consideration of instruments and techniques based on those theoretical foundations; some opportunity for field projects utilizing instruments and techniques. Prereq: Teaching experience. 3 cr.

867. LEGAL ASPECTS OF SCHOOL ADMINISTRATION

A study of the legal aspects of school administration emphasizing federal and state laws which establish the duties, privileges, and responsibilities of school board members, superintendents, principals, and teachers. Consideration will be given to the legal aspects of school district organization, negotiation procedures and personnel policies, fiscal operations, school building construction, compulsory attendance, pupil transportation services and the current legal issues involved in state and federal aid to education. Prereq: Ed. 861 and 863. 3 cr.

871. PRINCIPLES OF PERSONNEL SERVICES

Examination of the theoretical foundations which influence the practical functioning of personnel services: counseling, guidance, measurement, administration, speech, hearing, reading, psychology, social work, consultation, research, health, placement and special education. 3 cr.

872. COUNSELING THEORY AND PRACTICE

Introduction in the art and science of counseling. The basic approaches to counseling are examined with emphasis upon their philosophical foundations. 3 cr.

873. PSYCHOLOGY OF VOCATIONAL DEVELOPMENT

Investigation of the psychological and informational factors which influence entrance into and movement within occupations. 3 cr.

874. ORGANIZATION AND ADMINISTRATION OF PERSONNEL SERVICES

Investigation of the organizational patterns and administrative procedures which influence the effectiveness of personnel services programs. Emphasis upon the elements of productive supervisory and staff relationships. Prereq: Ed. 871. 3 cr.

875. PRACTICUM IN COUNSELING

Supervised application of counseling theory and practice by involvement in role-playing experience. Prereq: Ed. 872. 3 cr.

876. COUNSELING AND GUIDANCE IN THE ELEMENTARY SCHOOL

Application of the principles and procedures of counseling and guidance in meeting the developmental needs of the elementary school pupil. Prereq: Ed 871 or Ed. 872. 3 cr.

877. GROUP COUNSELING

Investigation of counseling and guidance approaches as they apply in group situations. Emphasis upon group dynamics as it relates to counseling and guidance outcomes. Prereq: Ed. 872. 3 cr.

878. ADVANCED COUNSELING THEORY AND PRACTICE

A detailed investigation of the counseling relationship: its characteristics, process, and outcomes. Prereq: Ed. 871 and Ed. 872. 3 cr.

879. ADVANCED PRACTICUM IN COUNSELING

Supervised application of advanced counseling theory and practice in involvement in actual counseling experiences. Verbatim samplings of counseling practice will be analyzed and evaluated. Inexperienced students may be assigned supervised field work. Prereq: Ed. 878. 3 cr.

880. RESEARCH IN PERSONNEL SERVICES

Investigation of research design and methodology in the personnel services. Prereq: Ed. 889. 3 cr.

881. METHODS AND TECHNIQUES OF EDUCATIONAL RESEARCH

A critical study of the principal quantitative methods employed in the investigation of educational problems. Prereq: Ed. 785 and permission of the instructor. 3 cr.

882. RESEARCH PROBLEMS IN EDUCATION

Prereq: Permission of the instructor. 2-6 cr.

Education

883. ADVANCED PSYCHOLOGY OF HUMAN LEARNING

Special topics in the field of educational psychology with emphasis on the learning process: (a) examination of learning situations in the classroom in the light of experimental research; (b) examination and evaluation of learning situations in the light of the major theories of learning. Prereq: Ed. 757. 3 cr.

886. PHILOSOPHY OF EDUCATION

Current educational objectives and practices and the philosophical foundations upon which they are based. Prereq: Ed. 757 and Ed. 759. 3 cr.

887. THE HISTORY OF EDUCATIONAL IDEAS

All of the modern theories, practices, and present-day conflicts about education have their stems in the past. Some of the scholarship of the social sciences as well as the materials from the history of education will be related to contemporary educational viewpoints. A better understanding of the bases of American ideas about education should result from this approach. 3 cr. (*Offered in Extension and Summer Session only.*)

888. EDUCATION IN FOREIGN COUNTRIES

Educational developments in selected foreign countries are examined in relation to the cultural background and present-day needs of the people. The sociological and psychological factors that influence the educational policy and the structure of each national school system. 3 cr. (*Offered in Extension and Summer Session only.*)

889. PSYCHOLOGICAL TESTS IN PERSONNEL SERVICES

Study of those tests and evaluative instruments which have particular utility in the area of personnel services. Sample tests will be studied in order to determine their strengths and weaknesses. Prereq: 871, 872. 3 cr.

890. UTILIZATION OF TESTING IN PUBLIC EDUCATION

Methods of utilizing test data for predictive and analytical purposes in public schools. Emphasis given to problems of school-wide or community-wide magnitude. Prereq: 785. 3 cr.

895, 896. SEMINAR IN CONTEMPORARY EDUCATIONAL ISSUES AND PRACTICES

A detailed analysis of selected contemporary educational issues and practices. Consideration will be given to experimental projects that have explored the rationale, operational requirements, and effectiveness of these practices and the practical considerations involved in the introduction of these practices into a local school system. Various sections will consider different educational practices and issues, e.g., team teaching, flexible scheduling, and the ungraded school. The subtitle indicates the specific area of study. Students may repeat the course for different areas of study. Prereq: Teaching experience. 3-6 cr.

899. MASTER'S THESIS

3.9 cr.

Courses in Problems of Teaching High School Subjects

These courses are offered by related academic departments.

The following courses are devoted to a study of problems of objectives, selection, and organization of subject matter, teaching and testing techniques and classroom management in the teaching of the respective subjects. To be admitted into one of these courses the student must have completed, with a satisfactory grade, Educ. 758 or 858 and, in addition, the courses in the subject and related subjects designated as prerequisites to the respective courses in this group. A student who desires to be considered for supervised teaching must complete with a satisfactory grade one of these courses in the subject in which he hopes to do supervised teaching.

AGRICULTURE-EDUCATION (AG-ED) 650. PRINCIPLES OF AGRICULTURAL EDUCATION
3 cr.

AGRICULTURE-EDUCATION (AG-ED) 651, 652. METHODS OF TEACHING AGRICULTURAL MECHANICS
1 cr.

AGRICULTURE-EDUCATION (AG-ED) (792). PLANNING FOR TEACHING
4 cr.

ART-EDUCATION (ART-ED) 791. PROBLEMS OF TEACHING ART IN SECONDARY SCHOOLS
3 cr.

ART-EDUCATION (ART-ED). 792. PROBLEMS OF TEACHING ART IN ELEMENTARY SCHOOLS
3 cr.

BIOLOGY-EDUCATION (BI-ED) 791. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL BIOLOGY
3 cr.

ENGLISH-EDUCATION (ENG-ED) 791. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL ENGLISH
3 cr.

HISTORY-EDUCATION (HIST-ED) 791. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HISTORY AND OTHER SOCIAL STUDIES
3 cr.

HOME ECONOMICS-EDUCATION (HE-ED) 791. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HOME ECONOMICS
3 cr.

Education

LANGUAGE-EDUCATION (LANG-ED) 791. PROBLEMS IN THE TEACHING OF FOREIGN LANGUAGES IN THE HIGH SCHOOL

3 cr.

MATHEMATICS-EDUCATION (MATH-ED) 791. PROBLEMS IN THE TEACHING OF HIGH-SCHOOL MATHEMATICS

3 cr.

MUSIC-EDUCATION (MUS-ED) 791. PROBLEMS IN THE TEACHING OF SECONDARY SCHOOL MUSIC

3 cr.

MUSIC-EDUCATION (MUS-ED) 792. PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL MUSIC

3 cr.

PHYSICAL EDUCATION (PE-ED) 792. PROBLEMS OF TEACHING PHYSICAL EDUCATION IN THE ELEMENTARY SCHOOL

3 cr.

Electrical Engineering (83)

Alden L. Winn, *Chairman*; Joseph B. Murdoch, *Graduate Adviser*

To be admitted to graduate study in Electrical Engineering a student should have completed work in his major field equivalent to that currently required of undergraduates at the University of New Hampshire.

All students will be required to complete two basic courses, E.E. 801, Field Theory, and E.E. 811, Network Analysis, at the beginning of their graduate program, or furnish evidence of equivalent preparation. These two courses and those numbered below 800 are normally offered annually. Other courses numbered above 800 are offered on the basis of the requirements of the graduate students. Those who intend to undertake graduate work in Electrical Engineering must consult with the department graduate adviser in order to plan their programs of study. With the consent of the department a student, who through industrial experience has satisfied the objectives of a thesis, may be permitted to substitute approved course work for the thesis requirement.

Courses numbered between 600 and 699 may be taken for graduate credit by non-Electrical Engineering majors only.

Permission of the instructor is required for enrollment in all Electrical Engineering graduate courses.

652. INDUSTRIAL ELECTRONICS FUNDAMENTALS

Application of electronics to industrial processes. 2 rec; 1 lab; 3 cr.

706. ADVANCED CIRCUIT THEORY

Steady-state and transient analysis, derivation of fundamental formulas and constants, application of Laplace transforms. 3 rec; 1 conf; 4 cr.

725. ADVANCED ANALYSIS OF ALTERNATING-CURRENT MACHINERY

Steady-state and transient analysis of alternating- and direct-current machines. 3 rec; 1 lab or conf; 4 cr.

741-742. FUNDAMENTALS OF ACOUSTICS

The development of the acoustical wave equation for gases, solids, and liquids; reflection, refraction, and absorption; characteristics of acoustic sources; directivity of multi-source arrays; acoustical measurements and architectural acoustics; airborne noise control. Prereq: Physics 502 and Math. 527. Mr. Frost. 1 rec; 2 hrs each course; 2 cr. each course.

757. ELECTRONIC SYSTEMS ANALYSIS AND DESIGN

Techniques in coding, storage, and transfer of information. Analysis and design of electronic systems. 3 rec; 3 cr.

762. ILLUMINATION

Radiation, fundamental processes in gases, atomic spectra, sources of visible and near visible energy, lamp circuitry, illumination design, control of light, photometry, and color. Mr. Murdoch. 2 cr.

TECH. 780. ENGINEERING ANALYSIS

The basic principles and analytical methods employed in the solution of complex problems in the various branches of engineering. 2-3 cr.

781. INSTRUMENTATION

Analysis and design of equipment for measurement, instrumentation, and control. Mr. Blanchard, Mr. Clark. 3 rec; 1 lab; 4 cr.

782. CONTROL SYSTEMS

Fundamental principles involved in the design and analysis of feedback control systems. Mr. Blanchard, Mr. Clark. 3 rec; 1 lab; 4 cr.

801. FIELD THEORY

The application of Maxwell's Equations to static and dynamic field problems. Introduction to the general wave equation in rectangular, cylindrical and spherical coordinate systems. Mr. Frost, Mr. Stotz. 4 cr.

802. ELECTROMAGNETIC WAVE THEORY

Advanced topics in electromagnetic field theory including waves in non isotropic media and antenna characteristics. Mr. Frost, Mr. Stotz. Prereq: E.E. 801. 4 cr.

803. PRINCIPLES OF MICROWAVE SYSTEMS

Wave propagation in free space; dielectrics and conductors; normal modes of waveguides and cavities; interactions between traveling waves

Electrical Engineering

and electrons; generation at high frequencies. Prereq: E.E. 802. Mr. Frost. 3 rec; 1 lab or conf; 4 cr.

804. ANTENNAS

Theory and design of electromagnetic radiating systems. Mr. Frost. Prereq: E.E. 802. 3 rec; 1 lab or conf; 4 cr.

811. NETWORK ANALYSIS

The application of matrices and determinants, linear graph theory, Laplace and Fourier transforms, complex-variable theory, and time- and frequency-domain concepts to the analysis of linear networks and systems. Mr. Murdoch, Mr. Glanz. 4 cr.

812. NETWORK SYNTHESIS

Characteristics of one- to n-port network functions, realizability criteria and synthesis of one-, two- and three-element-kind driving-point and transfer functions. Introduction to active network synthesis techniques. Mr. Murdoch, Mr. Melvin. Prereq: E.E. 811. 4 cr.

813. NONLINEAR NETWORKS

Analysis of passive networks with non-linear and time-varying parameters. Mr. Melvin. 3 rec and 1 conf; 4 cr.

814. NETWORK APPROXIMATION

Filter design through approximation in the time and frequency domains. Mr. Murdoch, Mr. Melvin. Prereq: E.E. 812. 4 cr.

815. LINEAR ACTIVE CIRCUITS

Development of equivalent circuits for solid-state devices; analysis and design of linear networks containing these devices. Mr. Winn, Mr. Skutt. 3 rec; 1 lab or conf; 4 cr.

816. NONLINEAR ACTIVE CIRCUITS

Analytical and graphical techniques for circuits designed for pulse and other non-sinusoidal signals; and solid-state or vacuum-tube devices used in the switching mode. Mr. Winn, Mr. Skutt. 3 rec; 1 lab or conf; 4 cr.

821. TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER

Line characteristics, steady-state performance, symmetrical components, lightning and over-current protection, relaying. 3 rec; 1 lab or conf; 4 cr.

831. SEMICONDUCTOR ELECTRONICS

A study of the underlying electronic properties of present and future semiconductor devices. The internal behavior of diodes and transistors is studied and related to linear and nonlinear (switching) applications. Other devices such as field-effect transistors, masers, and integrated circuits are also studied. Mr. Skutt. Prereq: E.E. 609. 4 cr.

839. STATISTICAL THEORY OF COMMUNICATIONS

Generalized harmonic analyses of periodic, aperiodic and random func-

tions. Elements of probability, random variables, ensembles and distributions; time and ensemble averages. Correlation function and power density spectra of random processes. Sampling theory and detection of periodic signals in noise. Optimum linear systems, optimum filtering, and prediction. Mr. Clark. 4 cr.

840. INFORMATION THEORY

Discrete and continuous probability, fundamentals of encoding, basic information theory and stochastic processes. Mr. Glanz, Mr. Clark. 4 cr.

851. ADVANCED CONTROL SYSTEMS

Advanced topics in analysis and design of linear and nonlinear feedback control systems. Mr. Blanchard, Mr. Clark. Prereq: E.E. 782. 3 rec; 1 lab or conf; 4 cr.

898. ELECTRICAL ENGINEERING PROJECT

Independent theoretical and/or experimental investigation of an electrical engineering problem. E.E. Staff. 1-4 cr. per semester.

899. ELECTRICAL ENGINEERING THESIS

6 cr.

For additional courses see Technology, page 149.

English (49)

John C. Richardson, *Chairman*

The Department of English offers two advanced degrees, the Master of Arts and the Master of Science for Teachers. The Master of Science for Teachers is a terminal degree, one designed for the high school teacher. The Master of Arts is, primarily, the first step to the doctoral degree; the candidate will ordinarily be preparing for teaching in a college or university.

For the Master of Arts degree a reading knowledge of French, German, or Latin is required of the candidate. For the Master of Science for Teachers degree no foreign language is required.

The student who is a candidate for the degree of Master of Science for Teachers must take 30 hours of work in English numbered above 700 that will not be a repetition of his undergraduate course work.

The student who is a candidate for the Master of Arts degree must earn 30 credits: no more than 12 in literature courses numbered 750-800; 12 in literature courses numbered 850-898 (6 of which must be in graduate seminars: 885-898); and 6 credits in a thesis (899). A student taking a course numbered 850-885, though attending the undergraduate lectures, must do

English

additional work assigned by his instructor and prepare a paper on an agreed subject connected with his study, a copy of which must be submitted to the chairman of the department.

All graduate students, even though they attend undergraduate classes, are marked on the graduate level.

If a student intends to complete his work for the Master of Arts degree in one year, he should register for three thesis credits each semester.

703, 704. WRITING NON-FICTION

Mr. Murray. Prereq: Permission of instructor. 3 cr.

705. ENGLISH GRAMMAR

Required of students in the English Teaching program and open to other students with permission of instructor. Mr. Goffe. 3 cr.

709, 710, 711. CRITICAL ANALYSIS

Analysis of three forms of writing: 709, exposition; 710, fiction; 711, poetry. Mr. Bingham and Mr. Richardson. 3 cr.

(751). HISTORY OF THE ENGLISH LANGUAGE

Mr. Carnicelli. 3 cr.

753. OLD ENGLISH

Mr. Carnicelli. 3 cr.

754. Beowulf

Mr. Carnicelli. 3 cr.

755, 756. CHAUCER

Mr. Underwood. 3 cr.

757, 758. SHAKESPEARE'S PLAYS

Mr. Schultz and Mr. Hapgood. 3 cr.

759. MILTON

Mr. Schultz. 3 cr. (Alternate years; offered in 1967-1968.)

760. BOSWELL'S JOHNSON

3 cr. (Not offered in 1967-1968.)

761. WORDSWORTH

Mr. Miller. 3 cr. (Alternate years; not offered in 1967-1968.)

762. BROWNING

Mr. Daggett. 3 cr. (Alternate years; offered in 1967-1968.)

763, 764. ENGLISH LITERATURE IN THE SIXTEENTH CENTURY

Mr. Schultz. 3 cr. (Alternate years; not offered in 1967-1968.)

765, 766. ENGLISH LITERATURE IN THE SEVENTEENTH CENTURY

Mr. Underwood. 3 cr. (Alternate years; offered in 1967-1968.)

767, 768. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY

Mr. Maynard. 3 cr.

769, 770. THE ENGLISH ROMANTIC PERIOD

Wordsworth, Coleridge, Lamb, Hazlitt, Byron, Shelley, Keats, DeQuincey.
Mr. Miller. 3 cr. (Alternate years; offered in 1967-1968.)

771, 772. VICTORIAN PROSE AND POETRY

Major non-fictional prose from Carlyle to Stevenson and major poetry
from Tennyson to Hardy. Mr. Miller. 3 cr. (Alternate years; offered in
1967-1968.)

773, 774. BRITISH LITERATURE OF THE TWENTIETH CENTURY

Mr. Daggett and Mr. Richardson. 3 cr.

775. NEW ENGLAND RENAISSANCE

Emerson, Thoreau, and other transcendentalists. Mr. Daggett. 3 cr. (Al-
ternate years; not offered in 1967-1968.)

776. AMERICAN NOVEL IN THE NINETEENTH CENTURY

Mr. Webster. 3 cr. (Alternate years; offered in 1967-1968.)

777. AMERICAN POETRY OF THE NINETEENTH CENTURY

Mr. Daggett. 3 cr. (Alternate years; offered in 1967-1968.)

779, 780. AMERICAN LITERATURE OF THE TWENTIETH CENTURY

Mr. Nicoloff. 3 cr.

781, 782. INTRODUCTION TO ENGLISH DRAMA

The development of English drama, exclusive of Shakespeare, from the
Middle Ages to the present. Mr. Hapgood. 3 cr. (Alternate years; offered
in 1967-1968.)

783, 784. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES

Mr. Bingham and Mr. Miller. 3 cr.

(851). HISTORY OF THE ENGLISH LANGUAGE

3 cr.

853. OLD ENGLISH

3 cr.

854. *Beowulf*

3 cr.

855, 856. CHAUCER

3 cr.

857, 858. SHAKESPEARE'S PLAYS

3 cr.

859. MILTON

3 cr. (Alternate years; offered in 1967-1968.)

860. BOSWELL'S JOHNSON

3 cr. (Not offered in 1967-1968.)

861. WORDSWORTH

3 cr. (Alternate years; not offered in 1967-1968.)

English

862. BROWNING

3 cr. (Alternate years; offered in 1967-1968.)

863, 864. ENGLISH LITERATURE IN THE SIXTEENTH CENTURY

3 cr. (Alternate years; not offered in 1967-1968.)

865, 866. ENGLISH LITERATURE IN THE SEVENTEENTH CENTURY

3 cr. (Alternate years; offered in 1967-1968.)

867, 868. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY

3 cr.

869, 870. THE ENGLISH ROMANTIC PERIOD

3 cr. (Alternate years; offered in 1967-1968.)

871, 872. VICTORIAN PROSE AND POETRY

3 cr. (Alternate years; offered in 1967-1968.)

873, 874. BRITISH LITERATURE OF THE TWENTIETH CENTURY

3 cr.

875. THE NEW ENGLAND RENAISSANCE

3 cr. (Alternate years; not offered in 1967-1968.)

876. THE AMERICAN NOVEL IN THE NINETEENTH CENTURY

3 cr. (Alternate years; offered in 1967-1968.)

877. AMERICAN POETRY OF THE NINETEENTH CENTURY

3 cr. (Alternate years; offered in 1967-1968.)

879, 880. AMERICAN LITERATURE OF THE TWENTIETH CENTURY

3 cr.

881, 882. AN INTRODUCTION TO ENGLISH DRAMA

3 cr. (Alternate years; offered in 1967-1968.)

883, 884. THE ENGLISH NOVEL OF THE EIGHTEENTH AND NINETEENTH CENTURIES

3 cr.

885, 886. SEMINAR — PROBLEMS IN MEDIEVAL LITERATURE

Mr. Underwood. 3 cr.

887. SEMINAR — STUDIES IN SIXTEENTH-CENTURY LITERATURE

Mr. Schultz. 3 cr. (Not offered in 1967-1968.)

888. SEMINAR — PROBLEMS IN MILTON SCHOLARSHIP AND CRITICISM

Mr. Schultz. 3 cr.

889. SEMINAR — STUDIES IN SHAKESPEARE

Mr. Hapgood. 3 cr.

890. SEMINAR — STUDIES IN ENGLISH DRAMA

Mr. Hapgood. 3 cr.

892. SEMINAR — STUDIES IN RESTORATION LITERATURE

Mr. Underwood. 3 cr. (Not offered in 1967-1968.)

893. SEMINAR — STUDIES IN EARLY SEVENTEENTH-CENTURY LITERATURE
Mr. Schultz. 3 cr.
899. MASTER'S THESIS
6 cr.
-

Entomology (29)

James G. Conklin, *Chairman*

For admission to graduate study in Entomology an applicant is expected to have had adequate preparation in undergraduate Entomology and related sciences. Students lacking the necessary background courses may be required to complete certain courses which do not carry graduate credit before they are admitted to candidacy for a degree.

The program of graduate study is designed to meet the needs of those students who are planning to take further work leading to a career in professional entomology.

A thesis is required of all candidates for the Master's degree.

704. MEDICAL ENTOMOLOGY

Insects and arachnids in relation to public health. The more important disease carriers, their biologies, and means of control. Adapted especially for students who are interested in public health or medicine. Elective for juniors and seniors. Mr. Bickle. 2 lec; 1 lab; 3 cr.

707-708. ADVANCED ENTOMOLOGY

The anatomy and physiology of insects. Systematic entomology. Mr. Conklin and Mr. Bickle. Open to others than Entomology majors by permission of the Department Chairman. 2 lec; 2 lab; 4 cr.

709-710. ADVANCED ECONOMIC ENTOMOLOGY

Problems in applied Entomology; the literature of economic entomology. Investigational methods. Studies of the specialized phases of entomology. Mr. Conklin and Mr. Bickle. Required of Entomology majors. Open to others than Entomology majors by permission of the Department Chairman. 1 to 3 cr.

801, 802. GRADUATE ENTOMOLOGY

Mr. Conklin and Mr. Bickle. Hours and credits to be arranged.

899, (899). GRADUATE ENTOMOLOGY. MASTER'S THESIS

Mr. Conklin, Mr. Bickle, and Mr. Reeves. Hours and credits to be arranged. 6-10 cr.

Forest Resources

Forest Resources (30)

Paul E. Bruns, Chairman

Students admitted to graduate study in Forestry are expected to have completed a course of study equivalent to that required for the degree of Bachelor of Science in Forestry. Those who lack undergraduate training in any of the necessary fields may be required to complete certain courses in these subjects without graduate credit before being admitted to candidacy for a degree.

Candidates for the Master's degree in Forestry must pass an oral examination. A thesis may or may not be required.

711. STATISTICAL METHODS II

An intermediate course in statistics. All students elect the applied phase with the basic phase optional for additional credit. Applied phase presents concepts of statistical models, tests of significance, analysis of variance in one-way and multi-way classifications, and factorial experiments. Introduction to covariance, multiple regression, and analysis with unequal subclass numbers; introduction to chi-square tests, discrete distributions, non parametric statistics, and sampling. Basic phase parallels and supplements applied phase; algebraic derivation of computing formulae, study of models and derivation of expected values; matrix representation of experimental design and multiple regression models; introduction to least squares. Prereq: An elementary statistics course. 3-4 cr.

730. FOREST TREE IMPROVEMENT

A consideration of the genetics of forest tree improvement with emphasis on variation in natural populations, the basis for selection of desired characters and the fundamentals of controlled breeding. The application of principles will be directed toward silviculture, management and utilization. Mr. Hocker. Prereq: Permission of instructor. (Alternate years; offered in 1967-1968.) 2 lec; 1 lab; 3 cr.

734. FOREST FISH AND GAME

Fish and wildlife population dynamics and the theory of game management. The characteristics of important game species and management techniques useful in the northeastern forest habitat. Elective with permission of instructor. Mr. Olson. 3 lec; 1 lab; 4 cr.

746. FOREST MANAGEMENT RESOURCE SURVEY

Forest land use coordination. Multiple uses treated separately and as integrated concurrent uses of forested lands. Forest management for water, recreation, wildlife and range benefits. Mr. Wallace. Prereq: For. Res. 544, 661, or permission of the instructor. 2 lec; 1 lab; 4 cr.

755. FOREST WILDLIFE MANAGEMENT

Readings and discussions on the properties of wildlife species and the various phases of management including public relations, law enforcement and control of undesirable species. Students should be prepared to participate in week-end field trips to game management areas in New England. Mr. Olson. Prereq: For. Res. 734 or permission of the instructor. 2 lec; 1 lab; 3 cr.

758. PHOTOGRAMMETRY IN FORESTRY

Elementary principles of photogrammetry with emphasis on their application to all phases of forestry. The value and use of aerial photos in forest typing, planimetric, and topographic mapping; measurement of area and volume estimation. Prereq: Permission of instructor. 2 lec; 1 lab; 3 cr.

763. FOREST RECREATION SEMINAR

The recreational use of forest lands including factors that affect demand and supply for recreation. Planning for state and local recreational use emphasizing the economic and social aspects. Prereq: Permission of the instructor. Mr. Wallace. Two 1½-hr. sessions; 3 cr.

764. FOREST INDUSTRY ECONOMICS

Application of business methods and economics in the establishment and operation of forest industries; planning for minimum cost operations and the profitable use of capital in forest enterprises. Mr. Wallace. Prereq: Permission of the instructor. 2 lec; 1 lab; 3 cr.

801, 802. FOREST MANAGEMENT SEMINAR

Seminar discussions of current literature, plans and principles, and new developments in the general field of forest management. Mr. Bruns and members of the department. Prereq: Permission of the instructor. 2 rec; 2 cr.

803. APPROACH TO RESEARCH

The meaning of science and the scientific method. The application of logic in the scientific method. The general principles and techniques of scientific research. A general survey of statistical procedures as a tool for research. The organization of investigative work including problem analyses, working plans, and the preparation of reports. Mr. Foster and members of the department. Prereq: Permission of the instructor. 2 cr.

805. UTILIZATION SEMINAR

Conferences, discussions, and reports on assigned topics. Consideration of current literature and developments in the general field of wood utilization. Mr. Hill. Prereq: Permission of the instructor. 2-hour seminar; 2 cr.

806. LOGGING ECONOMICS SEMINAR

Conferences, discussions, and reports on assigned topics. Considerations

Forest Resources

of current developments in the field of raw material procurement. Mr. Foster. Prereq: Permission of the instructor. 2-hour seminar; 2 cr.

809, 810. WILDLIFE MANAGEMENT SEMINAR

Discussions and assigned reports on current investigations and developments in wildlife management. Mr. Olson. Prereq: Undergraduate courses in wildlife management. 2-hour seminar; 2 cr.

815. ADVANCED MENSURATION

Volume table construction and application, advanced studies of growth and yield and methods of prediction. Application of graphic and statistical solutions to these problems. Prereq: Permission of the instructor. 2 lec; 1 lab; 3 cr.

818. ADVANCED PHOTOGRAHMETRY IN FORESTRY

The application of aerial photogrammetrical techniques to specific forestry problems. The use of photographs for volume estimation including cull, volume tables, and species composition; use in fire control, range, timber and recreational management, road location, allocation of cut, and in designing large-scale resource inventories. Prereq: Permission of the instructor. 2 cr.

833. FOREST PROTECTION SEMINAR

Discussion and special problems based on the principles and techniques of forest protection. Mr. Weyrick. Prereq: For. Res. 660 or equivalent. 3 cr.

861, 862. INVESTIGATIONS IN (1) FOREST ECOLOGY, (2) PHOTOGRAHMETRY, (3) WOOD UTILIZATION, (4) GAME MANAGEMENT, (5) MENSURATION, (6) FOREST ECONOMICS, (7) FOREST MANAGEMENT, (8) LOGGING ECONOMICS

Work to be arranged according to the needs of individual students. Staff. Hours to be arranged. Prereq: Permission of the instructor. 2-4 cr.

899. THESIS

Hours and credits to be arranged to meet the needs of the individual student. Prereq: Graduate standing, and the permission of the instructor in the selected field of study. 6-10 cr.

French and Italian

Samuel J. Stokes, Jr., Chairman

The Department of French and Italian offers courses leading to two degrees, Master of Arts and Master of Science for Teachers in French.

To be admitted to graduate study for the M.A. degree, a student must have completed an undergraduate major in French or the equivalent thereof.

He must also submit scores of the Graduate Record Examination, both the Aptitude Test and the Advanced Test in French.

To satisfy course requirements for the M.A., the student must complete at least 30 credits: 24 in course work and 6 for the Master's thesis. 18 of the course credits must be in French courses, 12 in French courses numbered 800 or above. 6 of the 24 course credits may be taken in related departments.

The thesis for the M.A. must embody results of independent investigation and be written in a form acceptable to the Department. It must be submitted to the thesis director before April 20, of the academic year in which the degree is to be granted.

To be admitted to graduate study for the M.S.T. degree in French, a candidate must have satisfactorily completed the requirements for secondary school teacher certification in that language.

To satisfy course requirements for the M.S.T., the student must complete at least 30 credits. 24 of the course credits must be in French courses, 12 in French courses numbered 800 or above. 6 of the credits may be taken in related departments, and 6 may be transferred from an accredited NDEA institute granting graduate credits.

The candidate for the M.S.T. degree must pass a departmental oral and written examination on or before April 20 of the academic year in which the degree is to be granted.

French (56)

741. FRENCH LITERATURE OF THE MIDDLE AGES

Readings in the epic, lyric poetry and the romance. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

742. FRENCH LITERATURE OF THE RENAISSANCE

Rabelais, Marguerite de Navarre, Ronsard, Du Bellay, Montaigne and others. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

759-760. FRENCH LITERATURE OF THE SEVENTEENTH CENTURY

759: Historical and literary background of French classicism, poetry, Corneille, Pascal, and Molière's early plays. 760: Molière, Racine, La-Fontaine, Mme. de LaFayette, Boileau, and LaBruyère. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

761-762. EIGHTEENTH CENTURY FRENCH LITERATURE AND THOUGHT

761: Precursors of Age of Enlightenment — Bayle, Fontenelle, Montesquieu; Voltaire's early works; Marivaux and others. 762: Diderot, Encyclopedists, later Voltaire, Laclos, Rousseau and others. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

French and Italian

767-768. NINETEENTH CENTURY FRENCH LITERATURE

767: Romanticism; Mme. de Stael, Chateaubriand, Stendahl, Lamartine, Hugo, Vigny, Musset. 768: Late Romanticism; Realism; Balzac, Flaubert, Hugo, the Parnassian school. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

(770.) INTRODUCTION TO MODERN FRENCH POETRY

Baudelaire, Rimbaud, Mallarmé, Valéry, and others. Prereq: 506. 3 cr. (Alternate years; offered in 1967-1968.)

781-782. CONTEMPORARY FRENCH NOVEL AND THEATER

781: Maeterlinck, Vildrac, Apollinaire, Gide, Proust, Mauriac and others.

782: Malraux, Bernanos, Sartre, Camus, Anouilh, Giraudoux and others. Conducted in French. Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

788. SEMINAR IN FRENCH LITERATURE

A study of French authors at the discretion of the instructor. Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

790. ADVANCED LANGUAGE AND STYLE

Translation of literary texts, intensive study of the principal techniques of style, *explication de textes*. Open to qualified students who have had a minimum of six hours of French courses numbered 641 and above. 3 cr.

795, 796. SPECIAL STUDIES IN FRENCH LANGUAGE AND LITERATURE

Individual guided study in special topics; with training in bibliography and organization of material. Examples of topics which may be selected are: the work of a major French author, specific topics in any area of French literature, such as literary criticism in the Seventeenth Century. Staff. Prereq: Permission of the Department Chairman. Variable credit.

841. FRENCH LITERATURE OF THE MIDDLE AGES

Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

842. FRENCH LITERATURE OF THE RENAISSANCE

Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

859-860. FRENCH LITERATURE OF THE SEVENTEENTH CENTURY

Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

861-862. EIGHTEENTH CENTURY FRENCH LITERATURE

Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

867-868. NINETEENTH CENTURY FRENCH LITERATURE

Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

(870.) INTRODUCTION TO MODERN FRENCH POETRY

Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

881-882. CONTEMPORARY FRENCH NOVEL AND THEATER

Prereq: Fr. 506. 3 cr. (Alternate years; not offered in 1967-1968.)

888. SEMINAR IN FRENCH LITERATURE

Prereq: Fr. 506. 3 cr. (Alternate years; offered in 1967-1968.)

890. ADVANCED LANGUAGE AND STYLE

Prereq: Open to qualified students who have had a minimum of six hours of French courses numbered 641 and above. 3 cr.

895, 896. SPECIAL STUDIES IN FRENCH LANGUAGE AND LITERATURE

Prereq: Permission of Department Chairman. Variable credit.

899. MASTER'S THESIS

6 cr.

Genetics Program (97)

Frank K. Hoornbeek, *Chairman*

The interdepartmental Genetics Program offers graduate work leading to the degrees of Doctor of Philosophy and Master of Science.

A qualified student is admitted to the program with the approval of the chairman of the Genetics Program and the chairman of the department in which he has a major interest. Students will be expected to have adequate preparation in the biological and physical sciences including mathematics. Students lacking these requirements may be admitted but will be required to complete certain courses without graduate credit.

The Program is conducted by faculty members from the departments of Animal Sciences, Biochemistry, Botany, Forest Resources, Microbiology, Plant Science, and Zoology as well as other faculty from the Agricultural Experiment Station and the U. S. Forest Service Northeastern Forest Experiment Station. Areas of specialization in the program are: animal genetics, cytology and cytogenetics, and plant genetics.

Master of Science Degree

The program for the Master of Science degree is formulated by the student with the approval of his guidance committee. Candidates for the M.S. degree will be required to complete a thesis and pass an oral examination covering his graduate courses and thesis.

Doctor of Philosophy Degree

The chairman of the Genetics Program with the concurrence of the chairman of the department of major interest will nominate the student's guidance and doctoral committees. Specific course requirements will be developed by the student and his guidance committee. Students must demon-

Genetics Program

strate a reading knowledge of two foreign languages, usually French and German, and must complete a dissertation on original research in genetics.

Courses Available in the Genetics Program

802. DESIGN OF EXPERIMENTS

The philosophy of experimental design and how it relates to standard statistical designs. Topics include the roles of replication and randomization, factorially arranged treatments, latin squares, incomplete non-factorial designs, fractional replication and confounding, and crossover designs. Mr. Urban. Prereq: For. Res. 701 and Math 411 or permission of instructor. 3 cr. (Alternate years; offered in 1967-1968.)

812. ADVANCED STATISTICAL METHODS

Methods and techniques for handling typical problems which arise in the analysis of data. Topics include the multiple comparison of means, analysis of unweighted means, proportional subclass numbers, weighted squares of means, orthogonal polynomials and least squares. Mr. Urban. Prereq: For. Res. 701 and Math 411 or permission of instructor. 3 cr. (Alternate years; not offered in 1967-1968.)

821. BIOMETRICAL GENETICS

Statistical aspects of estimating genetic parameters associated with quantitative traits. The theory underlying estimation of components of variance from various experimental designs, phenotypic and genotypic correlations, construction of selection indices, and the use of collateral and ancestral relatives to estimate breeding value. Mr. Urban. Prereq: Genetics 812, Math 411 and either An. Sci. 703 or Pl. Sc. 774. 3 cr. (Alternate years; offered in 1967-1968.)

898. GENETICS SEMINAR

Presentation and discussion of selected genetic topics. Staff. 1 cr. May be repeated.

899, (899). MASTER'S THESIS

6-10 cr.

999, (999). DOCTORAL RESEARCH

Courses Available in the Cooperating Departments

These courses are fully described below and under the course descriptions of the appropriate department for the convenience of the student.

Animal Sciences (25)

703. ANIMAL GENETICS

Mendelian and quantitative inheritance in animals, principles and systems of selection. Mr. Collins. Prereq: 3 cr. of genetics or permission of instructor. 2 lec; 1 lab; 3 cr.

812. QUANTITATIVE GENETICS AND ANIMAL IMPROVEMENT

Gene frequency, genetic and environmental variation, heritability, fitness, selection, inbreeding, outbreeding, correlated characters. Mr. Collins. Prereq: 3 cr. Each genetics and statistics. 3 lec; 3 cr.

Botany (27)

754. CYTOLOGY

The structure, physiological behavior, and development of cells. The cellular basis of heredity. Mr. Schreiber. Prereq: One year each in the biological sciences and in chemistry. 3 cr.

764. MICROTECHNIQUE

Methods of embedding, sectioning, and staining plant tissues, and introduction to microscopy. Miss Nast. Prereq: Bot. 411 or Bot. 503. 3 cr.

Forest Resources (30)

711. STATISTICAL METHODS II

An intermediate course in statistics. All students elect the applied phase with the basic phase optional for additional credit. Applied phase presents concepts of statistical models, tests of significance, analysis of variance in one-way and multiway classifications, and factorial experiment. Introduction to covariance, multiple regression, and analysis with unequal subclass numbers; introduction to chi-square tests, discrete distributions, non-parametric statistics and sampling. Basic phase parallels and supplements applied phase; algebraic derivation of computing formulae, study of models and derivation of expected values; matrix representation of experimental design and multiple regression models; introduction to least squares. Prereq: An elementary statistics course. 3-4 cr.

730. FOREST TREE IMPROVEMENT

A consideration of the genetics of forest tree improvement with emphasis on variation in natural populations, the basis for selection for desired characters and the fundamentals of controlled breeding. The application of principles will be directed toward silviculture, management, and utilization. Mr. Hocker. Prereq: Permission of instructor. 2 lec; 1 lab; 3 cr. (Alternate years; offered in 1967-1968.)

Microbiology (47)

803. MICROBIAL CYTOLOGY

The fine structure of bacteria and related organisms (Prokaryotic Prokaryotes). Application of current techniques for the demonstration and isolation of external appendages, cell walls, cytoplasmic membrane, protoplasts, inclusions, and chromatin bodies. Prereq: Microb. 701. 2 lec; 2 lab; 4 cr.

Genetics Program

804. MICROBIAL GENETICS

An introduction to genetic principles and methodology applicable to microorganisms; fine structure of genetic material, mutation, selection, adaptation, recombination, transformation, and transduction. Prereq: Permission of the instructor. 2 lec; 2 lab; 4 cr.

Plant Science (32)

774. METHODS AND THEORY OF PLANT BREEDING

History and use of plant breeding systems, including bulk and pedigree methods, recurrent selection, gamete selection and testing. Mr. Peirce. Prereq: 3 cr. in genetics. 3 cr. (Alternate years; offered in 1967-1968.)

851. PLANT GENETICS

Linkage, euploidy, aneuploidy, cytoplasmic inheritance, mutation and genetics of disease resistance. Prereq: Zool. 706 or equivalent. 3 lec; 3 cr. (Alternate years; not offered in 1967-1968.)

853. CYTOGENETICS

Chromosome aberrations and their behavior. Effect of radiation on chromosomes. Mapping and laboratory technique in cytogenetic analysis. Mr. Rogers. Prereq: 3 cr. each genetics and cytology. 2 lec; 1 lab; 3 cr. (Alternate years; not offered in 1967-1968.)

Zoology (70)

(706), 706. GENETICS

The physical basis of inheritance, expression, and interaction of the hereditary units, linkage, and variation. The application of Mendelian principles to plant and animal breeding. Mr. Hoornbeek. Prereq: Zool. 412 or equivalent. 3 lec; 1 lab; 4 cr.

736. ADVANCED GENETICS

Genetic recombinations and mutations, gene action in terms of physiological effects at the developmental and adult stages. Mr. Hoornbeek. Prereq: Zool. 706 or equivalent. 3 cr.

738. ADVANCED GENETICS LABORATORY

Problems and projects with small mammals and *Drosophila*, stressing physiological genetics. Student background and interest to determine content. Mr. Hoornbeek. Prereq: Zool. 736 or equivalent. 2 cr.

Geology

Herbert Tischler, *Chairman*

Admission to graduate study in Geology will be granted to applicants who have had adequate preparation in the geological and cognate sciences. Students lacking these requirements may be admitted, but will be required to complete certain courses which do not give graduate credit. A candidate for the Master's degree shall pass an oral or written examination covering his graduate courses and his thesis.

716. MINERALOGY OF CLAYS

The composition of various types of clays; the structure and properties of clay minerals; the origin and mode of occurrence of the clay minerals and clay materials; the utilization of clays in the arts and industry. Mr. Gaudette. Prereq: Geol. 613, 512; or permission of the instructor.

741. PRINCIPLES OF GEOCHEMISTRY

The chemical approach to the interpretation of geological processes with emphasis on the principles which control the distribution and migration of elements in geological environments. Mr. Gaudette. Prereq: Geol. 613 or permission of the instructor.

754. SEDIMENTOLOGY

The properties of sediments and sedimentary rocks, the sedimentary processes and environments, correlation procedures and stratigraphic principles. Mr. Tischler. Prereq: Geol. 401 and 512 or permission of instructor. 2 lec; 1 lab; 3 cr.

771-772. ECONOMIC GEOLOGY

First semester: the types of coal and their occurrence in the United States; petroleum, the structures in which it is found and the distribution and geology of oil fields, especially in the United States; industrial minerals and their utilization. Second semester; the metals, their ores, and the geology of important ore deposits. Mr. Meyers. Prereq: Geol. 512. 3 cr.

781. PHYSICAL GEOLOGY

The materials and structures of the earth and the erosive agents that modify them are described in the lectures and are examined and studied in the laboratory and on field trips. This course is for high school science teachers who need an introduction to the Earth Sciences. (Not available for credit after completing Geol. 401 or equivalent.)

782. HISTORICAL GEOLOGY

The history and development of the physical features of the earth and the development of life on the earth. Fossil organisms will be briefly surveyed in the laboratory and the methods of historical geology will be

Geology

illustrated in the laboratory and on field trips. Prereq: Geol. 781 or equivalent. This course is for high school science teachers who need an introduction to the earth sciences. (Not available for credit after completing Geol. 402 or equivalent.) Offered during Summer Session and in extension. To register one must be a certified science teacher with at least three years of teaching experience. 4 cr.

795. GEOLOGICAL PROBLEMS

Special problems by means of conferences, assigned readings, and field or laboratory work, fitted to individual needs from one of the areas listed below. Staff. Prereq: Permission of the instructor. 1-2 cr. This course may be repeated to a total of not more than 5 credits.

- | | |
|---------------------------------|----------------------------------|
| 1. Areal Geology | 11. Mineralogy, Advanced |
| 2. Geochemistry | 12. Optical Crystallography |
| 3. Geomorphology, Advanced | 13. Ore Deposits |
| 4. Geophysics | 14. Paleontology, Advanced |
| 5. Glacial Geology, Advanced | 15. Petrology, Advanced |
| 6. Groundwater Geology | 16. Regional Geology |
| 7. Historical Geology, Advanced | 17. Sedimentation |
| 8. Industrial Minerals | 18. Stratigraphy |
| 9. Micropaleontology | 19. Structural Geology, Advanced |
| 10. Mineral Fuels | |

797. GEOLOGY SEMINAR

Study of selected topics in both classical and modern geological thought. Prereq: Senior standing and permission of the instructor. 2 cr.

895. TOPICS IN GEOLOGY

The sections of this course provide an opportunity for advanced work on an individual or group basis. Prereq: Permission of Department Chairman and Staff concerned. 1-3 cr. Sections of this course are the same as those listed under Geology 795. May be repeated.

897. SEMINAR IN CONTEMPORARY GEOLOGY

A review and discussion of recent geological literature. The instructor, the format and the content will vary from year to year. Prereq: Permission of the Department Chairman and Staff concerned. May be repeated.

899. MASTER'S THESIS

6-10 cr.

German and Russian

Hermann W. Reske, *Chairman*

The Department of German and Russian offers programs leading to the degrees of Master of Arts and Master of Science in Teaching (both degrees in German only).

To be admitted to graduate study for either degree, a student must have met requirements substantially equal to those set up for an undergraduate major in German.

To satisfy requirements for the degree of Master of Science in Teaching of German, the candidate must complete at least 30 credits of approved graduate work. At least three credits must be selected from the seminars listed below; one seminar paper will be required. The candidate for the M.S.T. degree must pass the departmental comprehensive written examination.

To satisfy requirements for the degree of Master of Arts in German, the candidate must pass the departmental comprehensive written examination and *either*:

(a) complete 30 credits of graduate course work with at least three credits selected from the list of seminars; one seminar paper will be required, or

(b) complete 24 credits of graduate course work and write a thesis. (Six credits are awarded for the thesis, thus completing the total 30 credits established by the Graduate School as requisite for the degree.) The departmental comprehensive written examination must be passed before the student undertakes work on the thesis. If the student takes the examination in German, he may write the thesis in English; if he takes the examination in English, he must write the thesis in German. If he wants to do both in German, he may do so. The thesis must embody the results of independent investigation and be written in a form acceptable to the Department. It must be submitted to the Thesis Director five weeks before the date the degree is to be granted.

A candidate will be permitted to take the departmental comprehensive written examination only twice. If he fails in his first attempt, he must wait at least three months before taking it again.

German (57)

701. INTERMEDIATE COMPOSITION

A systematic study of style, shades of meaning, adequacy of expression. A thorough knowledge of German grammar is prerequisite. Practice in writing seminar papers and obtaining stylistic flexibility in the use of written German. Prereq: Ger. 501. Summer Session only. 2 cr.

German and Russian

703. INTERMEDIATE ORAL PRACTICE

For students with a fair knowledge of spoken German but who will need more fluency and accuracy of expression. Prereq: Ger. 507. Summer Session only. 2 cr.

705. ADVANCED ORAL PRACTICE

An intensive course in oral self-expression. Small groups only. Very detailed program for each lecture on assigned subjects. Prereq: Ger. 703. Summer Session only. 2 cr.

707. PRACTICAL PHONETICS

A study of the sound and rhythm of spoken German. Classroom discussions are supplemented by intensive use of the Language Laboratory. Summer Session only. 2 cr.

755. GERMAN LITERATURE OF THE AGE OF THE BAROQUE

German literature between Reformation and the Age of Enlightenment. Reading, interpretation, and critical analysis of prescribed prose, drama, and poetry with emphasis on the philosophical and social ideas of the time. Prereq: Ger. 605-606. 3 cr. (Alternate years; offered in 1967-1968.)

756. GERMAN LITERATURE OF THE AGE OF ENLIGHTENMENT

German literature from the Baroque period to the beginning of the period of Storm and Stress with emphasis on readings and interpretations of works of Lessing and Wieland. Prereq: Ger. 605-606. 3 cr. (Alternate years; offered in 1967-1968.)

757-758. THE AGE OF GOETHE

German literature of Storm and Stress and the Classical Period. Interpretation and critical analysis with emphasis upon selected works of Wagner, Klinger, Lenz, Schiller, and Goethe. Prereq: Ger. 606. 3 cr. (Alternate years; offered in 1967-1968.)

759-760. GERMAN ROMANTICISM

German literature from the end of the Eighteenth Century to 1830. Interpretation and critical analysis of prescribed prose, drama, and poetry of prominent writers and poets of the period, from Wackenroder to Eichendorff. Prereq: Ger. 606. 3 cr. (Alternate years; not offered in 1967-1968.)

761-762. THE AGE OF REALISM

Representative German writers, dramatists, poets, and novelists from the end of Romanticism to the beginning of Naturalism (1830-1880) will be read and discussed with a background of social and philosophical development. Prereq: Ger. 606. 3 cr. (Alternate years; not offered in 1967-1968.)

763-764. GERMAN LITERATURE SINCE 1880

From Naturalism to the present. Reading, interpretation, and critical

analysis of prescribed prose, drama and poetry of Hauptmann, Hofmannsthal, Rilke, Mann, Kafka. Prereq: Ger. 606. 3 cr. (Alternate years; offered in 1967-1968.)

781, 782. HISTORY AND DEVELOPMENT OF THE GERMAN LANGUAGE AND ADVANCED STYLISTICS

This course gives the student an insight into the history and development of the German language. Beginning with the Indo-European Period it traces the changes in sounds, structure and vocabulary to the establishment of modern German. A systematic study of style, shades of meaning, adequacy of expression. A thorough knowledge of German grammar is prerequisite. Practice in writing seminar papers and obtaining stylistic flexibility in the use of written German. Prereq: German 605-606. 3 cr.

791. METHODS OF THE TEACHING OF GERMAN

A critical study of modern language teaching on all levels from high school to college. The course emphasizes the practical approach of teaching and the use of modern equipment such as audio-visual aids, tape recorders, films, records, etc. The course is especially tailored for teachers of German in high school and colleges. 2 or 3 cr.

795, 796. SPECIAL STUDIES IN GERMAN LITERATURE

Individual guided study in special topics, with training in bibliography, note taking, organization of material. Examples of topics which may be selected by instructor and student in conference are: (1) Wolfram von Eschenbach: Parzival; (2) Walther von der Vogelweide: Lyrics; (3) Middle High German Popular Epics; (4) German Literature of the 17th Century; (5) Goethe's Poetry; (6) Goethe's Faust; (7) Heinrich v. Kleist; (8) German Romanticism; (9) 20th Century German Literature. Prereq: Permission of Department Chairman. Variable credit.

831. GERMAN CULTURE I, HISTORY

Summer Session only. 2 cr.

832. GERMAN CULTURE II, ART

Summer Session only. 2 cr.

833. GERMAN CULTURE III, FOLKLORE

Summer Session only. 2 cr.

855. GERMAN LITERATURE OF THE AGE OF THE BAROQUE

3 cr. (Alternate years; offered in 1967-1968.)

856. GERMAN LITERATURE OF THE AGE OF ENLIGHTENMENT

3 cr. (Alternate years; offered in 1967-1968.)

857-858. THE AGE OF GOETHE

3 cr. (Alternate years; offered in 1967-1968.)

859-860. GERMAN ROMANTICISM

3 cr. (Alternate years; not offered in 1967-1968.)

German and Russian

- 861-862. THE AGE OF REALISM
3 cr. (Alternate years; not offered in 1967-1968.)
- 863-864. GERMAN LITERATURE SINCE 1880
3 cr. (Alternate years; offered in 1967-1968.)
- 881, 882. HISTORY AND DEVELOPMENT OF THE GERMAN LANGUAGE AND ADVANCED STYLISTICS
3 cr.
883. SEMINAR: HISTORY AND DEVELOPMENT OF THE GERMAN LANGUAGE
Prereq: German 881. Summer Session only. 2 cr.
885. SEMINAR: MASTERPIECES OF THE AGE OF ENLIGHTENMENT
Mrs. Lawson. 3 cr.
886. SEMINAR: MASTERPIECES OF THE AGE OF GOETHE
Mr. Reske. 3 cr.
887. SEMINAR: MASTERPIECES OF THE 19TH CENTURY GERMAN LITERATURE
Mrs. Lawson. 3 cr.
888. SEMINAR: MASTERPIECES OF GERMAN LITERATURE AFTER 1880
Mr. Brandt. 3 cr.
- 895, 896. SPECIAL STUDIES IN GERMAN LITERATURE
Prereq: Permission of Department Chairman. Variable credit.
899. MASTER'S THESIS
6 cr.

History (53)

William R. Jones, *Chairman*

In general, the candidate for admission to graduate study in history should present evidence of having satisfactorily completed at least 24 semester credits as an undergraduate in courses in history, not including courses open to freshmen, with a grade of C or better. The History Department, however, reserves the right to judge each applicant on his individual merits. The requirements for the degree of Master of Arts in History are those on pages 24 to 26 of this catalog. The completed thesis must be submitted by April 1 of the year in which the degree is to be granted. A final examination is not required.

- 707, 708. COLONIAL AND REVOLUTIONARY AMERICAN HISTORY
Colonial beginnings in America, national rivalries, the English colonies, the Revolution, and our national life to 1789. Early forms of Americanism in the making. 3 cr.
-

711, 712. NINETEENTH CENTURY AMERICA

The historical factors, both domestic and international, involved in the development of the American Republic, its institutions and people, from the inception of the new nation in 1789 to the emergence of the United States as a world power in 1900. Mr. Jellison. 3 cr.

715, 716. TWENTIETH CENTURY AMERICA

United States history since 1896, from the triumph of industrialism on the national scene to the emergence of America as a world power in the nuclear age. Political, economic, and diplomatic developments. Mr. Greenleaf. 3 cr.

719, 720. THE FOREIGN RELATIONS OF THE UNITED STATES

Primarily the history of American diplomacy, with attention given to the non-diplomatic aspects of foreign relations. Mr. Long. 3 cr.

723. AMERICAN HISTORIOGRAPHY

An examination of the principal writings of American historians from the colonial period to the present time. Emphasis will be given to those works that pertain mainly to the American people and their immediate neighbors. Mr. Jellison. Prereq: Permission of the instructor. 3 cr.

725. BUSINESS HISTORY

A survey of the development of business enterprise and its institutions in Western Europe and the United States from the late Middle Ages to the era of the giant diversified corporation. Emphasis is placed on the role of the entrepreneur, the impact of public policy on business, and the case study of individual firms. Mr. Greenleaf. 3 cr. (Offered in the Whittemore School as Business Administration 725 and Economics 725.)

739, 740. THREE MEDIEVAL CIVILIZATIONS

A study of the demise of classical antiquity in the lands bordering the Mediterranean and the genesis and fruition of three new cultural traditions: the Latin Christian, the Islamic, and the Byzantine. Stress will be put on religious, literary and scholarly survivals and innovations from 400 A.D. to 1400 A.D. Mr. Jones. 3 cr.

743. RENAISSANCE AND REFORMATION

The history of Europe during the fifteenth and sixteenth centuries with primary emphasis on the Italian Renaissance, the Protestant Reformation, and the emergence of the national state. Mr. Isherwood. 3 cr.

747. THE AGE OF ABSOLUTISM

The theory and practice of absolutism from its origin in the seventeenth century to its apogee in enlightened despotism. Mr. Isherwood. 3 cr.

749. THE AGE OF REVOLUTION

Revolution as a socio-political phenomenon in its historical setting. Comparative approach to Puritan, American, and French revolutions with reference to contemporary movements. Mr. Gilmore. 3 cr.

History

756. TWENTIETH CENTURY EUROPE

European history in the twentieth century will be treated from the point of view of a civilization in a constant state of crisis. World War I, the inter-war period, World War II, and the attempts to solve the conflicts of modern society after that war in terms of new economic, political, and cultural patterns will represent the core of the study. The effects of extra-European influences, the loss of European primacy, and continued strife within the structure of the European state and cultural system. Mr. Heilbronner. 3 cr.

759. HISTORY OF MODERN SPAIN AND PORTUGAL

The Iberian states and their peoples from the coming of 19th century liberalism to the present. Political and social change will be emphasized but attention will be paid to imperial activity as well as to intellectual movements. External influences of European thought and activity will be considered as relevant to the study of two modernizing countries with persistent traditions. Mr. Wheeler. 3 cr.

761, 762. ENGLAND IN THE TUDOR AND STUART PERIODS

3 cr.

763, 764. HISTORY OF RUSSIA

The development of the Russian state from its foundation to its present status as a world power. The course is designed to increase the understanding of the present in terms of the past. Political developments, foreign relations, and intellectual and ideological currents. Mr. Heilbronner. 3 cr.

774. EUROPEAN HISTORIOGRAPHY

An examination of selected works of historical literature since the Reformation. Emphasis will be placed on the comparison of different schools of historical interpretation, the development of historical method, and the impact of Romanticism, Idealism, Nationalism, and Positivism on the composition of historical literature. Mr. Isherwood. 3 cr.

(781). HISTORY OF MODERN CHINA, 1850-1950

A study of the modernization of China. The course will be concerned with the political, social, and cultural changes which have occurred in China from its early contacts with the West to the establishment of the Communist Regime. Mr. Linden. 3 cr.

784. HISTORY OF SOUTHERN AFRICA SINCE 1820

A study of the struggle for political and economic control in the only region of Africa where European groups remain in power. With special attention to the development of European hegemony, the course will trace the impact of European imperialism, European settler nationalism, African nationalism, racial conflict, economic competition and industrialization, Apartheid, and assimilation. Included will be a discussion of official American policy in this region. Mr. Wheeler. 3 cr.

785. THE MODERN MIDDLE EAST

A history of the Middle East from the eighteenth century to the present time, with special attention given to the problems created by modernization and reform of the traditional society, the conservative reaction to reform, the impact of nationalism and the appearance of new ideologies. Mr. Voll. 3 cr.

(789). SEMINAR IN THE HISTORY OF SCIENCE

Selected topics, conducted through special lectures, individual study, oral, and written reports. The subject will vary from year to year. This course is the same as Phys. Sci. (789). *Cannot be used for credit in History without permission of the History Department.* Mr. Schneer. Prereq: Permission of adviser and instructor. 3 cr.

791. HISTORY-EDUCATION (HIST-ED). PROBLEMS IN THE TEACHING OF HIGH-SCHOOL HISTORY AND OTHER SOCIAL STUDIES

Bibliography and new interpretations of history; the social studies curriculum, past and present; aims and objectives in the social studies; selection and organization of teaching material; teaching and testing techniques. Special emphasis on teaching American history and the problems of American democracy. Open to students who have satisfactorily completed Hist. 503, 504; six credits in other history courses, exclusive of Hist. 401, 402; six credits from American Government, Principles of Economics, or Principles of Sociology; and Principles and Problems of Teaching in the Secondary School. Mr. Draves. 3 cr.

792. ADVANCED STUDY IN THE TEACHING OF WORLD HISTORY

6 cr. (Offered in Summer Session only. Admission limited to in-service high school teachers with permission of the Department of History.)

807, 808. SOURCES FOR THE STUDY OF COLONIAL AMERICAN HISTORY

For students who have taken Colonial and Revolutionary American History or the equivalent. Training in the methods of historical investigation and in the use of sources in the field of colonial American history. The preparation of papers based on source materials alone. Prereq: Permission of the instructor. 3 cr.

811, 812. SEMINAR IN NINETEENTH CENTURY AMERICAN HISTORY

For students interested in examining in depth certain significant conditions, trends, and aspects of American society during the nineteenth century. Mr. Jellison. Prereq: A course in United States history and the permission of the instructor. 3 cr.

815, 816. SEMINAR IN TWENTIETH CENTURY AMERICAN HISTORY

A specialized and analytical study of movements, institutions, personalities, and problems which have played a shaping role in the development of the United States between 1896 and the middle of the twentieth century. Research papers pertinent to seminar discussions will be required. Mr.

History

Greenleaf. Prereq: A course in United States history and the permission of the instructor. 3 cr.

835, 836. SEMINAR IN MODERN EUROPEAN HISTORY

Specialization in the study of the development of some major institutions and ideas which contributed to the structure and spirit of modern society. Research papers, relating to seminar discussions, will be required. Mr. Gilmore. Prereq: A course in modern European history and permission of the instructor. 3 cr.

861, 862. SEMINAR IN THE HISTORY OF ENGLAND IN THE TUDOR AND STUART PERIODS

Prereq: Permission of instructor. 3 cr.

863, 864. SEMINAR IN RUSSIAN HISTORY

The seminar will be concerned with the study of and research in specific, limited topics in nineteenth and twentieth century Imperial and Soviet history. Mr. Heilbronner. Prereq: A course in Russian history and permission of the instructor. 3 cr.

895, 896. READING AND RESEARCH IN HISTORY: (1) American Colonial History, (2) United States Since 1789, (3) Canada and Latin America, (4) Medieval Europe, (5) Modern Europe, (6) Ancient History, (7) Far East and India, (8) Near East and Africa, (9) European Historiography, (10) American Historiography, (11) Russia.

For independent study in an area in which no appropriate course is offered. To be chosen by a graduate student in history who wishes to take courses normally not open to him on a graduate basis. Hours to be arranged. Prereq: Permission of the instructor. 3 cr.

899. MASTER'S THESIS

6 cr.

Home Economics (31)

Marjory Wybourn, *Chairman*

Graduate work is offered leading to the degree of Master of Science in Home Economics with major emphasis in areas which strengthen professional competence in family, community, and educational services.

Each student's program will be planned to achieve personal and professional objectives of the individual and will be based on specific interests, ability, and undergraduate preparation. Selection of courses from the social sciences and other University departments will be encouraged.

Students admitted to the graduate program in Home Economics are expected to have had an undergraduate degree in Home Economics or a

related field. If there are deficiencies in the undergraduate program students may be admitted on condition that they complete specified prerequisites.

A candidate for a Master of Science degree in Home Economics is expected to fulfill the general requirements of the Graduate School and the following departmental requirements:

1. Home Economics -- a minimum of 12 semester credits, including one course in each of the following two areas: management and decision-making in the family and family development.
2. A minimum of 9 semester credits selected from the liberal arts or other areas which support the major.
3. Research — a minimum of 4 semester credits including: H.E. 897, Research Seminar, and H.E. 898, Research Project or H.E. 899, Thesis.

757, (757). HOME MANAGEMENT

The management of individual and family resources as related to human needs, values, and goals throughout the life cycle of the family. 3 cr.

765. HISTORY OF COSTUME

A broad historical survey of western world costume from primitive times to the present. The influence of social, religious, and political conditions of the eras studied to costume evolution. 3 cr.

768. SOCIO-PSYCHOLOGICAL ASPECTS OF CLOTHING

The analysis of research and theory in the social psychological aspects of clothing. An exploration and study of clothing behavior of individuals and groups. 3 cr.

769. ADVANCED TEXTILES

Investigation and evaluation of fabrics in everyday use. Consumption of textiles with emphasis on economic and social implications. Prereq: H.E. 404 or equivalent. 3 cr.

771. EXPERIMENTAL FOODS

Application of the experimental method of study to the principles underlying food preparation. Includes lab and individual problem study. Prereq: H.E. 418. 3 cr.

778. FOOD AND NUTRITION TRENDS AND DEVELOPMENTS

Investigation and evaluation of current problems in food production, preparation and preservation or of current nutritional developments. The course may be carried as an independent directed study. 3 cr.

783. FAMILY RELATIONSHIPS

A study of husband-wife, parent-child, and sibling interactions throughout the family life cycle. 3 cr.

791. METHODS IN HOME ECONOMICS EDUCATION

Home economics education in the school program, curriculum materials, methods, and resources in teaching home economics. 3 cr.

Home Economics

(792). METHODS IN FAMILY RELATIONS EDUCATION

A study of the methods and materials used in family relations education in high schools, colleges, churches and social agencies. 2-4 cr.

795, (795). PROJECTS IN CHILD DEVELOPMENT

Discussion, conferences, and supplementary projects based upon special interests of the student. Work with children in the University Nursery School or in other situations. Prereq: H.E. 426 and permission of the instructor. 1-3 cr each semester; maximum 6 cr.

796, (796). PROJECTS IN HOME MANAGEMENT

The student, under the guidance of the instructor, will undertake selected areas of study in the field of Home Management. Such investigations may include: (a) family finance, (b) consumer education, (c) management processes, (d) current research. 1-3 cr. each semester. Maximum of 6 cr.

797. NUTRITION SEMINAR

Theoretical approach to nutrient metabolism. Critical review of literature in the field of nutrition relative to the principles on which human nutrition is based. Prereq: H.E. 573. 3 cr.

(798), 798. SEMINAR IN HOME ECONOMICS EDUCATION

Recent developments and problems in teaching home economics at all levels. Individuals or small groups may work on specific problems in the field. 2 to 4 cr.

883. THE ADOLESCENT IN THE FAMILY

A study of the psycho-social development of the adolescent with attention given to the heterosexual and familial relationships of the adolescent. 3 cr.

895, (895). PROJECTS IN FOOD AND NUTRITION

The student, under the guidance of the instructor, may select a study, creative project, or field experience or independent work in the area of food and nutrition. 1-3 cr. each semester; maximum of 6 cr.

(896), 896. PROJECTS IN CLOTHING AND TEXTILES

The student, under the guidance of the instructor, may undertake selected areas of investigation in the field of clothing and textiles. Such investigations may include: (a) philosophy of textiles and clothing in education, (b) current development of textiles, (c) the textile industry, (d) social and psychological interpretation of dress, (e) current research readings in clothing and textiles. 1-3 cr each semester; maximum of 6 cr.

897. RESEARCH SEMINAR

Survey, evaluation, and use of research in the field of Home Economics. An introduction to methods and techniques used in defining a problem for study, collecting data, analyzing, and writing a report. 2 cr.

(898), 898. RESEARCH PROJECT

A study or project which may be selected in lieu of a thesis. To be taken concurrently with H.E. 897. 2-4 cr.

899. THESIS

6 cr.

Language, General (55)

This course is taught by members of the Departments of French and Italian, German and Russian, and Spanish and Classics. Students wishing to take this course should consult Dr. Charles H. Leighton, Chairman of the Department of Spanish and Classics.

LANGUAGES-EDUCATION (LANG-ED) 791. PROBLEMS IN THE TEACHING OF MODERN LANGUAGES IN THE HIGH SCHOOL

The special objectives, methods, and devices of modern language teaching in high school. For prospective or actual teachers of French, German, and Spanish. Prereq: Intermediate French, German, Spanish; and grade of C or better in Ed 758 or one year's teaching experience. 3 cr.

Mathematics (84)

M. Evans Munroe, *Chairman*

The Mathematics Department offers courses leading to three graduate degrees: Master of Science for Teachers, Master of Science, and Doctor of Philosophy

Master of Science for Teachers

Admission requirements: Completion of all requirements for secondary school teacher certification in Mathematics.

Degree requirements: (1) Ten semester courses approved by the Department. These will normally be taken from the courses numbered 801-829 and will usually include the six courses numbered 803-808. (2) A comprehensive examination based primarily on material in courses 803-808.

Master of Science

Admission requirements: Mathematics 761-762 or 767-768 or the equivalent of one of these sequences elsewhere. Preference will be given to applicants who have completed both these sequences.

Mathematics

Degree requirements: (1) Ten semester courses approved by the Department. These must be chosen from courses numbered 701-799 or 830-899. At least six of the ten must be from the 830-899 group. (2) A comprehensive examination based primarily on material in the courses taken.

Doctor of Philosophy

Admission requirements: Same as for M.S.

Degree requirements: (1) Course work as prescribed by the Department. This will normally include all the courses numbered 830-840 together with several courses numbered 860-898. (2) Proficiency in reading mathematical literature in two of the three languages: French, German, and Russian. (3) Experience in teaching equivalent to at least one-half time for one year. (4) Qualifying examination. This will test the candidate's knowledge of advanced mathematics generally and, unlike the comprehensive examinations for Master's degrees, will not necessarily be confined to the subject matter taken. (5) Thesis. This is the principal item in the Ph.D. program. New and original results will be required. At present, thesis work is available in the fields of algebra, functional analysis, and topology and applied math.

COURSES NUMBERED BETWEEN 600 AND 699 MAY BE TAKEN FOR GRADUATE CREDIT BY NON-MAJORS ONLY.

601-602. FOUNDATIONS OF THE NUMBER SYSTEM

Postulates and mathematical structures. Various mathematical systems showing the nature and significance of the fundamental principles of arithmetic. Intended primarily for elementary school teachers. Prereq: Consent of instructor. 3 cr.

629. METHODS OF APPLIED MATHEMATICS I

Solutions of ordinary differential equations by D-operators, Laplace Transforms, and by series; representation of functions by definite integrals (Gamma, Beta, and error functions); Bessel functions; Fourier Series. Prereq: Math. 527. 3 rec; 4 cr.

630. METHODS OF APPLIED MATHEMATICS II

Vector analysis (line, surface, and volume integrals); elementary variational techniques; development of some partial differential equations by Laplace Transforms and by Green's functions. Prereq: Math. 629. 3 rec; 4 cr.

A maximum of four of the following courses may be applied to the degree of M.S. in Mathematics.

741. MATHEMATICAL STATISTICS I

Sampling theory; estimation of parameters; the multivariate normal distribution. Prereq: Math. 542. 3 cr.

742. MATHEMATICAL STATISTICS II

Testing statistical hypotheses; confidence intervals; regression and cor-

relation; nonparametric methods, and other topics. Prereq: Math. 741. 3 cr.

753-754. METHODS AND TECHNIQUES OF MODERN COMPUTATION

Methods of numerical analysis which are believed to be particularly suitable for high-speed computation, including some newly developed methods. Methods for making analytical approximations. An introduction to programming techniques, assembly and compiler programs, interpretive systems and symbolic operations. In the laboratory portion of the course, the practical aspects of modern computation, such as loss of precision, round-off error, overflow and underflow, etc., will be illustrated by means of short problems on both the desk calculator and the digital computer in the UNH Computation Center. A long-range project for investigation on the computer will be assigned. Prereq: Math. 527. 3 rec; 1 lab; 4 cr.

755. FUNDAMENTAL CONCEPTS OF GEOMETRY

Systems of postulates of various geometries; geometric invariants; synthetic and analytic projective geometry; introduction to non-Euclidean geometry, topology, and the elementary differential geometry of curves and surfaces. Prereq: Math. 426. 3 cr.

756. TOPICS IN NUMBER THEORY

Elementary properties of integers; the Euclidean algorithm; divisibility; diophantine equations of the second degree; selected topics in diophantine approximation and number-theoretic functions. Prereq: Math. 531. 3 cr.

761. HIGHER ALGEBRA I

The integers; the rational and complex number systems; congruences; polynomials; groups; rings; integral domains; fields. Prereq: Math. 531. 3 cr.

762. HIGHER ALGEBRA II

Vector spaces and transformations; matrices and determinants. Prereq: Math. 531. 3 cr.

767. REAL ANALYSIS I

The real number system; elements of set theory; theory of limits; continuous functions and their properties; differentiability and the mean value theorem. Prereq: Math. 531. 3 cr.

768. REAL ANALYSIS II

The Riemann integral; uniform convergences; double and iterated limits; applications of double limit theorem to series, limits under the integral sign and existence theorems for differential equations. Prereq: Math. 531. 3 cr.

771. GROUP THEORY AND PRINCIPAL IDEAL DOMAINS

Finite groups and their applications; Galois theory; Sylow theorems;

Mathematics

structure of principal ideal domains with applications to elementary divisor theory; unique factorization domains. Prereq: Math. 761. 3 cr.

781. THEORY OF APPROXIMATION

The theorems of Weierstrass on approximation of continuous functions; the Tschebycheff approximation problem; Tschebycheff polynomials; trigonometric polynomials of best approximation; interpolation; the formulas of Lagrange and Newton; trigonometric interpolation. Prereq: Math. 426. 3 cr.

782. NONLINEAR DIFFERENTIAL EQUATIONS

Phase plane analysis of lineal systems and nonlinear conservative systems; stability theorems; limit cycles and periodic solutions; the Van der Pol equation; the method of Kryloff and Bogoliuboff. Prereq: Math. 527. 3 cr.

783. INTRODUCTION TO DIFFERENTIAL GEOMETRY

A first course in the metric differential geometry of curves and surfaces in Euclidean space. Prereq: Math. 527. 3 cr.

784. INTRODUCTION TO TOPOLOGY

Elementary point-set topology in metric and topological spaces, in particular the real line and plane. Prereq: Math. 531. 3 cr.

786. INTRODUCTION TO THEORY OF DIFFERENTIAL EQUATIONS

Existence and uniqueness theorems for ordinary differential equations; theory of linear ordinary differential equations of order n; oscillation and comparison theorems for second order linear ordinary differential equations; partial differential equations of the second order. Prereq: Math. 531. 3 cr.

788. COMPLEX ANALYSIS

The complex number system; analyticity; elementary functions; Cauchy integral theorem and formulas; Taylor and Laurent series; singularities and residues; conformal mapping. Prereq: Math. 531. 3 cr.

THE FOLLOWING COURSES MAY BE APPLIED TO THE DEGREE OF M.S.T. IN MATHEMATICS AND TO NO OTHER GRADUATE DEGREE IN MATHEMATICS.

801-802. FUNDAMENTAL CONCEPTS OF MATHEMATICS FOR TEACHERS

An introduction to the most fundamental concepts of analysis, geometry, and algebra. Basic elements of set theory; a survey of the real and complex number systems; the integers and the concept of an integral domain; introduction to groups; geometrics, Euclidean and non-Euclidean; functions, sequences, and the limit concept; the derivative and the differentiation of algebraic functions. 3 cr.

803-804. HIGHER ALGEBRA FOR TEACHERS

The integers, integral domains, and topics from number theory; equiva-

lent relations and congruences; real numbers, complex numbers, and fields; polynomials; group theory; elements of matrix theory; vectors and vector spaces; rings; Boolean algebra. 3 cr.

805-806. HIGHER GEOMETRY FOR TEACHERS

Systems of postulates of various geometries; geometric invariants; synthetic and analytic projective geometry; an introduction to non-Euclidean geometry and topology. 3 cr.

807-808. HIGHER ANALYSIS FOR TEACHERS

The real number system; variables, functions and limits; elements of set theory; numerical sequences and series; continuity; the derivative and the Riemann integral; maxima and minima. 3 cr.

809. PROBABILITY AND STATISTICS FOR TEACHERS

Permutations and combinations; finite sample spaces; random variables; binomial distributions; statistical applications. 3 cr.

811. COMPUTERS AND THEIR USES

Computing machines and modern numerical methods. Each student will have an opportunity to make use of the University computer. 3 cr.

814. TOPOLOGY FOR TEACHERS

Fundamental concepts of elementary topology; network and map problems; sets, spaces, and transformations. 3 cr.

816. THEORY OF NUMBERS FOR TEACHERS

Divisibility and primes; congruences; quadratic reciprocity; number theoretic functions; Diophantine equations; Farey fractions; algebraic numbers. 3 cr.

817. THEORY OF SETS AND ELEMENTARY LOGIC

An introduction. 3 cr.

819. THE REAL NUMBER SYSTEM

A postulational approach. Brief discussion of algebraic structures. Introduction to the sequences, limits, and continuity. 3 cr.

820. HISTORY OF MATHEMATICS

A problem-study approach to mathematical problems and solutions from the period of Greek mathematics until the 1950's will be used to present the history of mathematics.

821. A MODERN APPROACH TO GEOMETRY

The foundations and development of Euclidean geometry, with emphasis on the recent School Mathematics Study Group's recommendations in the field of high school geometry. 3 cr.

825. INTERNSHIP

Experience under the direction of a master teacher in teaching university level mathematics to superior high school students. This work will be

Mathematics

done in the Advanced Studies Program at St. Paul's School, Concord, N. H. 6 cr.

826. SELECTED TOPICS IN ALGEBRA

Topics selected to supplement the teacher's previous training in algebra; to be chosen from the following: linear algebra, vector spaces, groups, rings and ideals, fields. 3 cr.

827. SELECTED TOPICS IN GEOMETRY

Topics selected to supplement the teacher's previous training in geometry; to be chosen from among the following: analytic projective geometry; non-Euclidean geometry; transformation theory; elementary metric differential geometry; topology. 3 cr.

828. SELECTED TOPICS IN ANALYSIS

Topics selected to supplement the teacher's previous training in analysis; to be chosen from among the following: sequences and series of real functions Riemann integration; partial differentiation; complex functions; differential equations. 3 cr.

829. DIRECTED READING

A directed reading project on a selected topic in mathematics chosen to supplement the teacher's previous institute courses. A written examination will be required. 3 cr.

THE FOLLOWING ARE THE BASIC COURSES FOR BOTH THE M.S. AND PH.D. IN MATHEMATICS.

831. SET THEORY

Foundations of the theory of sets; ordinal and cardinal numbers; Zorn's lemma; applications. 3 cr.

833-834. ALGEBRA

Group theory of rings and ideals; fields and their transcendental and algebraic extensions; valuation theory; Galois theory; algebraic numbers. 3 cr.

835-836. REAL ANALYSIS

The theory of measure as developed by Lebesgue, Caratheodory, and others; the definitions and basic properties of the Lebesgue integral. Related topics will be considered with the choice varying from year to year. Sample supplementary topics; foundations of probability theory, Fourier series, Banach spaces, topological groups and Haar measure, the Daniell integral. 3 cr.

837-838. COMPLEX ANALYSIS

Complex numbers; analytic functions; complex integration; representation theorems; theory of residues. 3 cr.

839-840. TOPOLOGY

General topology. 3 cr.

848. GEOMETRY

Metric differential geometry of curves and surfaces in Euclidean spaces; tensor analysis; Riemannian geometry. 3 cr.

851-852. DIFFERENTIAL EQUATIONS

Ordinary differential equations; existence theory; linear equations; Sturm-Liouville theory; nonlinear autonomous systems; Poincare-Bendixson theory; partial differential equations; second order linear equations; initial value problems; hyperbolic equations; the Dirichlet problem. 3 cr.

855-856. APPLIED MATHEMATICS

Calculus of variations, integral equations; operator theory; distributions; Hilbert spaces. 3 cr.

THE FOLLOWING ARE ADVANCED COURSES PRIMARILY FOR PH.D. CANDIDATES, THOUGH THEY MAY BE ELECTED BY QUALIFIED M.S. CANDIDATES. IN EACH OF THESE THE CONTENT WILL VARY FROM YEAR TO YEAR. THUS, WITH THE CONSENT OF THE INSTRUCTOR, EACH OF THESE COURSES MAY BE TAKEN MORE THAN ONCE FOR CREDIT, EVEN CONCURRENTLY. NORMALLY, THE CONTENT WILL BE CHOSEN FROM AMONG THE TOPICS LISTED.

861, 862. TOPICS IN ALGEBRA

Algebraic number theory; algebraic geometry; ring theory; theory of modules; group theory; non-associative algebras. 3 cr.

863, 864. TOPICS IN ANALYSIS

Measure theory; calculus of variations; integral equations; boundary value problems; orthogonal series; theory of approximation; analytic number theory; Riemann surfaces. 3 cr.

865, 866. TOPICS IN TOPOLOGY

Algebraic topology; theory of sheaves; dimension theory; Riemann surfaces; homotopy theory. 3 cr.

867, 868. TOPICS IN GEOMETRY

Convexity; projective geometry; differential geometry; tensor analysis, 3 cr.

869, 870. TOPICS IN TOPOLOGICAL AND ALGEBRAIC ANALYSIS

Rings of functions; linear topological spaces; topological algebras; Hilbert spaces; rings of operators; topological groups; Lie groups; harmonic analysis. 3 cr.

871, 872. TOPICS IN DIFFERENTIAL EQUATIONS

Boundary value problems; asymptotic behavior and stability theory; non-linear equations; dynamic systems; classical theory of partial dif-

Mathematics

ferential equations; functional analysis and partial differential equations.
3 cr.

873, 874. TOPICS IN APPLIED MATHEMATICS

Linear and dynamic programming; differential equations; special functions. 3 cr.

875, 876. TOPICS IN PROBABILITY AND STATISTICS

Stochastic processes. 3 cr.

898. READING COURSES

Offered in the following areas: (a) Algebra, (b) Analysis, (c) Topology, (d) Geometry, (e) Topological and Algebraic Analysis, (f) Differential Equations, (g) Applied Mathematics, (h) Probability and Statistics. 3-6 cr.

999. PH.D. THESIS

Mechanical Engineering (85)

Robert W. Corell, *Chairman*; Douglas M. Norris, Jr., *Graduate Adviser*

The Mechanical Engineering Department offers programs of study, both from the viewpoint of the engineering sciences and engineering design, in applied mechanics, materials, and the thermal sciences leading to the degree of Master of Science in Mechanical Engineering. The programs provide the background required for careers in research, engineering design or teaching, or for further graduate study.

To be admitted to graduate study in Mechanical Engineering a student should have completed work equivalent to that required for a Bachelor of Science degree in his field at the University of New Hampshire.

A candidate for the degree of Master of Science shall be required to prepare and present an approved thesis unless excused by the Department. An oral examination covering the candidate's graduate work will be given whether or not a thesis is presented. If excused from the thesis requirement, the student must present a paper, the subject and scope of which shall be approved by his adviser.

Courses numbered between 600 and 699 may be taken for graduate credit by non-majors only.

Permission of the instructor and consent of the adviser is required for enrollment in all Mechanical Engineering graduate courses.

643. MACHINE DESIGN AND ANALYSIS

Analysis and design of mechanical elements and systems, utilization and

further development of the fundamentals of strength of materials and dynamics. 3 cr.

653. HEAT TRANSFER

Analysis of heat transfer phenomena; steady-state and transient conduction, radiation, and convection; engineering applications. 3 cr.

657-658. HEAT AND POWER SYSTEMS

The application of thermodynamics, fluid mechanics, combustion, heat transfer and other engineering sciences to the design and evaluation of heat and power systems. 2 lec; 1 lab; 3 cr.

663. MATERIALS II

Theoretical and experimental application of the theory of elasticity, dislocation theory, and fracture mechanics to the determination of physical design parameters of crystalline and amorphous solids. 2 lec; 1 lab; 3 cr.

671. NAVAL ARCHITECTURE I

Introduction to naval architecture; geometry and hull form delineation; hydrostatic characteristics of floating and submerged bodies; introduction to ship strength; computer applications to problems. 3 cr.

701. MACROSCOPIC THERMODYNAMICS

Behavior of thermodynamic systems consistent with the approach of Gibbs and Caratheodory. 3 cr.

702. STATISTICAL THERMODYNAMICS

An introduction to statistical thermodynamics. 3 cr.

726. EXPERIMENTAL MECHANICS

Experimental methods and their underlying theoretical bases are developed and applied to the measurement of stress, strain, and motion. 3 cr.

727. ADVANCED MECHANICS OF SOLIDS

Energy methods; beams on elastic foundation; introduction to thin plates and shells; elasticity; inelastic behavior; numerical methods. 3 cr.

728. ADVANCED DYNAMICS

The foundations of dynamics leading to Lagrange's equations and Hamilton's principle. Gyroscopic effects in mechanical systems. Vibrations. 3 cr.

729. KINEMATICS

The vector equations of relative motion are used to analyze mechanisms of varying complexity; graphical and analytical methods are used to analyze space linkages. 2 lec; 1 lab; 3 cr.

736. ANALYTICAL FLUID DYNAMICS

An analytical study of the dynamic behavior of fluids. Topics include

Mechanical Engineering

potential flow, development of the Navier-Stokes equations, turbulence, and boundary layer theory. 3 cr.

744. MECHANICAL VIBRATIONS

Review of simple linear systems concepts; nonlinear vibrations; many degrees of freedom; introduction to continuous systems. 3 cr.

746. CONTROL OF PHYSICAL SYSTEMS

Theory and methods for modeling and evaluating electromechanical, hydraulic, and pneumatic control systems. 3 cr.

751. GAS DYNAMICS

Basic equations of motion applied to compressible, ideal fluid flow; normal and oblique shock waves; vorticity and circulation; irrotational flow. Linear approach to two-dimensional flow problems. Method of characteristics. 3 cr.

755. INTERNAL COMBUSTION ENGINES

Application of basic and engineering science to the engineering problems of spark and compression ignition engines; design, management, and reporting of experimental studies. 2 lec; 1 lab; 3 cr.

756. TURBOMACHINERY

Application of basic and engineering science to the engineering problems of turbomachinery; design, management, and reporting of experimental studies. 2 lec; 1 lab; 3 cr.

764. X-RAY METALLOGRAPHY

Theoretical and experimental studies of x-ray diffraction. 3 cr.

772. NAVAL ARCHITECTURE II

Hydrodynamic resistances of surface ships and submerged bodies; model testing theory; powering and propellers; use of Standard Series tests; introduction to ship motion, control steering, and rudders; concepts of ship design; computer application to problems. 3 cr.

801. MECHANICS OF CONTINUOUS MEDIA

Analysis of three dimensional stress, strain, and velocity strain; tensor methods; equilibrium, compatibility, and constitutive equations of solids and fluids. Prereq: Math. 629. 3 cr.

802. IRREVERSIBLE THERMODYNAMICS

Non-equilibrium thermodynamics from the viewpoint of fluctuation theory. The Onsager reciprocal relations. Prereq: M.E. 701. 3 cr.

803. ADVANCED HEAT TRANSFER

The heat flux vector, conduction equation in several variables with solutions by various techniques; fluid and thermal boundary layer theory; heat transfer with phase changes. 3 cr.

808. THEORETICAL FLUID MECHANICS

The basic equations of fluid flow; potential flow; viscous flow. Prereq: M.E. 801. 3 cr.

810. COMPRESSIBLE FLUID FLOW

Equations of motion for real compressible fluid flow; theorems of vorticity and circulation; non-steady and nonlinear flow problems; boundary layer effects. Prereq: M.E. 751, Math. 630. 3 cr.

812. VIBRATIONS OF CONTINUOUS MEDIA

Vibrations of beams, plates, shells, and simple structures. Prereq: M.E. 744, Math 629. 3 cr.

820. PHYSICAL METALLURGY

Introduction to the electron theory of materials; entropy and free energy concepts of the solid state; diffusion in metals; nature and kinetics of selected solid-state reactions. 3 cr.

822. PHYSICAL CERAMICS

Characteristics of crystalline and noncrystalline ceramic solids; defect structures; diffusion in ceramic materials; nucleation, crystal growth, and solid-state reactions; kinetics of grain growth, sintering, and vitrification. 3 cr.

826. THEORY OF ELASTICITY

Two-dimensional problems using the Airy stress function and complex variable methods; torsion, finite difference, energy, and variational methods. Prereq: M.E. 727 or M.E. 801. 3 cr.

827. THEORY OF PLASTICITY

Analysis of stress and deformation in inelastic solids; general development of stress invariants, variational principle, stress-strain relations and yield and loading functions. Special emphasis on ideal plasticity, strain-hardening, creep, limit analysis and design. 3 cr.

829. THEORY OF PLATES AND SHELLS

Buckling and bending of thin plates; membrane theory of shells; bending of cylindrical shells. 3 cr.

891. TOPICS IN APPLIED MECHANICS

Content of course may vary from year to year. 3 cr.

892. TOPICS IN THERMODYNAMICS

Content of course may vary from year to year. 3 cr.

893. TOPICS IN MATERIALS

Content of course may vary from year to year. 3 cr.

894. TOPICS IN ENGINEERING DESIGN

Content of course may vary from year to year. 3 cr.

Mechanical Engineering

895-896. GRADUATE INDEPENDENT STUDY

Investigation of graduate level problems or areas germane to mechanical engineering. 1-3 cr.

899. MASTER'S THESIS

6-8 cr.

For additional courses see listing under Technology page 149.

Microbiology (47)

Lawrence W. Slanetz, *Chairman*

Students admitted to graduate study in Microbiology are expected to have had adequate preparation in the biological and physical sciences and in the basic courses in Microbiology. The candidate for the M.S. degree will be required to complete a thesis and pass an examination covering his graduate courses and thesis.

Candidates for the Ph.D. degree must demonstrate proficiency in reading microbiological literature in two foreign languages, usually French and German, must demonstrate to the Doctoral Committee a broad basic knowledge of the field of Microbiology, and must complete a dissertation on some original research in Microbiology.

701. ADVANCED MICROBIOLOGY

The growth, nutrition, and metabolism of microorganisms; consideration of cell structure and localization of function; aspects of genetic and non-genetic regulation of metabolism; study of the influences of chemical and physical factors of the environment upon microorganisms. Mr. Chesbro. Prereq: Microb. 503. 2 lec; 1 lab; 4 cr.

702. PATHOGENIC MICROBIOLOGY

The morphological, cultural, biochemical, serological, and pathogenic characteristics of microorganisms causing human and animal diseases. Mr. Metcalf. Prereq: Microb. 503. 2 lec; 2 lab; 4 cr.

705. IMMUNOLOGY AND SEROLOGY

The defensive elements possessed by man and animals which serve to protect them from infectious microorganisms. The principles of serological techniques used in the recognition and identification of biological materials including microorganisms. The preparation of vaccines and the production of antisera in animals. Mr. Metcalf. Prereq: Microb. 702. 2 lec; 2 lab; 4 cr.

706. VIROLOGY

The animal and plant viruses, including bacteriophages and the ricket-

tsiae; a consideration of techniques for the propagation and recognition of animal viruses; a study of the interactions between virus and host cell and the application to problems of plant or animal infections caused by viruses. Mr. Metcalf. Prereq: Microb. 702. 1 lec; 3 lab; 4 cr.

708. MARINE MICROBIOLOGY

Characterization of microbes in the sea as to taxonomy, physiology, ecology, and transformations of carbon, nitrogen, sulfur, and phosphorus; methods of sampling and enumeration; biogeochemistry; properties of sea water and the marine environment. Parallels to soil microbiology will be drawn. Mr. Jones. Prereq: Microb. 503 and Biochem. 751. 2 lec; 1 lab; 4 cr.

795, 796. PROBLEMS IN MICROBIOLOGY

Special problems, depending upon the training and desire of the student. Elective only upon consultation. Mr. Slanetz and staff. Credits to be arranged.

800. SYSTEMATIC BACTERIOLOGY

Procedures and methods for the classification of bacteria; review of modern systems of classification. Mr. Slanetz. Prereq: One year of Microbiology. 2 lec; 1 lab; 3 cr.

802. MICROBIAL PHYSIOLOGY

Microbial physiology is the study of the means by which microorganisms survive. It deals with the effects of nutritional, chemical, and physical factors on microbial growth; with the generation of activated metabolites during catabolism and the use of these metabolites for the synthesis of macromolecules; with the nongenetic mechanisms directing and regulating cellular metabolism; with the biochemical cytology of the microbial cell; and with evolutionary and ecological relationships among microbial species. Mr. Chesbro. Prereq: Biochemistry (may *not* be taken concurrently) and Microb. 503. 2 lec; 2 lab; 4 cr.

803. MICROBIAL CYTOLOGY

The fine structure of bacteria and related organisms. (Prokaryotic Prokaryotes). Application of current techniques for the demonstration and isolation of external appendages, cell walls, cytoplasmic membrane, protoplasts, inclusions, and chromatin bodies. Prereq: Microb. 701. 2 lec; 2 lab; 4 cr.

804. MICROBIAL GENETICS

An introduction to genetic principles and methodology applicable to microorganisms; fine structure of genetic material, mutation, selection, adaptation, recombination, transformation, and transduction. Prereq: Permission of the instructor. 2 lec; 2 lab; 4 cr.

Microbiology

897-898. MICROBIOLOGY SEMINAR

Reports and discussions on microbiological literature and recent developments in microbiology. Mr. Slanetz and staff. Prereq: Permission of the instructor. 1 cr.

899. MASTER'S THESIS

6-10 cr.

999. DOCTORAL RESEARCH

Music

Donald E. Steele, *Chairman*

The Department of Music offers programs leading to the degrees Master of Arts in Music, and Master of Science in Music Education.

Master of Arts in Music

Admission to this program is dependent upon a B.A. degree in Music or its equivalent from an accredited institution. Placement examinations in music theory, music history, and in piano are administered by the Department of Music. Students not meeting standards in these phases of achievement will be required to take undergraduate courses to meet their deficiencies. A reading test in German is also required.

Concentration in studies for the above degree is in the field of Music History and Music Theory. The degree is not organized as a terminal degree in itself, but does prepare a student for work at the Doctorate level. The content of the degree emphasizes the disciplines of bibliography, research, the writing of papers, analytical studies of music literature, readings in source material and advanced theory. The following courses are required: Music 855, 856, 857, 858, 891, 892, 893, 894. The remainder of the courses may be drawn from the 700 series in Music or the 600, 700, and 800 series in other departments with the permission of the adviser. Sufficient electives are required to total 30 credits.

Master of Science in Music Education

Admission to this program is dependent upon an appropriate Bachelor's Degree in Music Education or its equivalent in an accredited college. A placement examination is administered by the Department of Music. Deficiencies must be made up.

The goal of this degree is to develop a stratum knowledge at the graduate level in the fields of music education, performance, history, theory and independent study. Each candidate will be required to complete ONE

of the following: a professional paper; a field of study in music education; a satisfactory recital appearance; a major composition, orchestration, or band arrangement; the preparation and conducting of a major work in public performance for band, orchestra, or choir. The following courses must be taken: Music 855, 893, Music Education 796, 883 or 884. Also required are 6 credits from the following courses in education: Education 841, 858, 865, 871, 883, 885, 886, and the 700 courses taught by the Educational Department. Vocal or instrumental study at the 800 level is required to the minimum of 4 credits. The maximum of 9 credits is allowed if the graduate recital option is elected. Sufficient electives are required to total 30 credits.

Music (63)

701. MASTERS OF THE RENAISSANCE

Important composers of the fifteenth and sixteenth centuries and their works: Vittoria, Palestrina, Byrd, and others. 2 cr.

703. ROMANTIC MUSIC OF THE NINETEENTH CENTURY

The sonata form as a basis for the symphonies, concerti, chamber music, and keyboard works of Beethoven, Berlioz, Schubert, Mendelssohn, Schumann, Brahms, Franck, Chopin, and Liszt. Romantic elements contained in the development of harmony orchestration, sonority, expressive content. The rise of the short piano piece, the German art song, the symphonic poem, nationalism in music. 2 cr.

704. TWENTIETH CENTURY MUSIC

Music of the twentieth century, including its literature, its trends, and an analysis of techniques, styles, forms, and expression. 2 cr.

705. THE LIFE AND WORKS OF BEETHOVEN

The piano sonatas, symphonic works, and the string quartets. Lectures, analysis, reports, required readings, and listening. 2 cr.

707-708. SURVEY OF OPERA AND ORATORIO

A historical and musical survey of the opera and oratorio from their common birth, through the development of each specific form to the present day. Particular stress is given to political and religious influences. 2 cr.

709-710. SURVEY OF PIANOFORTE LITERATURE

The history and development of keyboard literature from Bach to the present. A discussion and performance of the works of Bach, the sonatas and concertos of Haydn, Mozart, Beethoven, Schubert, the Romantic composers, and of contemporary writers. 2 cr.

719-720. COUNTERPOINT

First semester: Sixteenth century polyphony based on the style of

Music

Palestrina. Second semester: free instrumental counterpoint based on the styles of Bach and Handel. Twentieth century counterpoint will be discussed in the closing classes of the course. Prereq: Mus. 523-524 or permission of instructor. 2 cr.

721-722. CANON AND FUGUE

Free counterpoint in three and four parts, double counterpoint, the writing of simple two-part inventions, choral preludes, etc. The canonic and fugal studies will be based largely upon the works of Bach and will have as their objective the composition of a two-, a three-, and a four-voiced fugue. Prereq: Mus. 719-720 or permission of instructor. 2 cr.

723-724. COMPOSITION

The various smaller harmonic forms, the variation, the rondo, and the sonata forms will serve as models for composition. Prereq: Permission of the instructor. 2 cr.

725-726. ORCHESTRATION AND CHORESTRATION

Instruments and methods of combining them into coherent arrangements arriving at successful balances for the band and orchestral arranger. The characteristics, range and tone quality of the instruments are fully covered and transcriptions are made. Orchestral effects are studied. Chorestration is offered during the latter part of the second semester. The techniques of writing for solo voices, for mixed voices, men's and women's voices, are taken up through the medium of arrangements, and original work. Prereq: Permission of the instructor. 2 cr.

731. MUSIC IN THE MEDIEVAL PERIOD

A study in depth of the music in medieval times. Periods considered include plainsong, music of the Mass, secular monophony, beginnings of polyphony, French and Italian Ars Nova. 2 cr.

733. MUSIC OF THE BAROQUE

A study of early, middle, and late baroque music and its various schools. The cantatas, lute and keyboard music, the early concerto and sonata are studied in detail. The literature of Bach and Handel is investigated. 2 cr.

734. MUSIC IN THE CLASSICAL PERIOD

A study of the music of the rococo and classical periods. The following subjects will be investigated: "style galant," opera seria and opera buffa, the keyboard sonata, and the music of Haydn and Mozart. 2 cr.

817, (817). APPLIED MUSIC FOR GRADUATE CREDIT

(1) Piano; (2) Organ; (3) Violin, Viola; (4) Violoncello; (5) Voice; (6) Woodwind; (7) Brass; (8) Percussion. Further development of technique, music interpretation and repertory. Emphasis will also be

directed toward the functional use of the instrument in the schoolroom. Prereq: Must exhibit sufficient proficiency to warrant graduate study. Permission of the Department Chairman and the student's graduate supervisor. Audition required. A student may register for credit in the same courses in successive years with the approval of his major professor. Music staff. 1-2 cr.

855. INTRODUCTION TO BIBLIOGRAPHY

A study of the bibliography of music. The student will become familiar with the reference materials of music, dictionaries, journals and periodicals, and with major monographs and editions. 3 cr.

856. READINGS IN MUSIC HISTORY: ANTIQUITY TO 1600

The student will have the opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

857. READINGS IN MUSIC HISTORY: 1600-1820

The student will have the opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

858. READINGS IN MUSIC HISTORY: 1820 TO THE PRESENT

The student will have the opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

891, 892. RESEARCH SEMINAR

Guidance in individual research projects. Permission of instructor. 3 cr.

893. THEORY SEMINAR

Through reading, analysis, and composition this course is designed to acquaint the student with music theory from the Middle Ages to Monteverdi. Permission of instructor required. 3 cr.

894. THEORY SEMINAR

Theory and practice from the Baroque to contemporary music. Performance practice in the Baroque and later periods. Score analysis. 3 cr.

Music Education (64)**751, 752. TECHNIQUES AND METHODS IN CHORAL MUSIC**

A lecture workshop course touching upon some of the problems and solutions in the organization and performance of high school and college glee clubs and community choirs. Emphasis is placed on techniques of choral conducting and rehearsal, repertory, and materials. Offered to Mus. Ed. students who wish to place a greater emphasis on a vocal option in the Mus. Ed. curriculum rather than instrumental. A student taking 751, 752 may substitute them for two of the instrumental techniques and methods courses. 3 cr.

791. PROBLEMS IN THE TEACHING OF SECONDARY SCHOOL MUSIC

The application of educational principles to the teaching and learning

Music

of music, and the organization of the music curriculum on the junior and senior high-school levels. The adolescent voice and the classification of voices; the selection of vocal and instrumental materials to fit the needs of the individual group, in order to insure the maximum growth and musical development of the students; and the building of unified concert programs. Problems of administration and management, and the relationship of the teacher to school and community. Observation of music programs in secondary schools. Prereq: Educ. 758. 3 lec; 1 lab; 3 cr.

792. PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL MUSIC

Aims, scope, and organization of materials and activities in the elementary schools in keeping with modern trends in educational philosophy. The child voice, its care and development. A demonstration of materials and methods for the various grades. Observations of elementary school music. Prereq: Educ. 758. 3 lec; 1 lab; 3 cr.

796. ORGANIZATION AND ADMINISTRATION OF SCHOOL MUSIC GROUPS

Problems of organizing and administering school orchestras, bands, glee clubs, choruses and small ensembles, such as objectives, motivation, schedule, discipline, equipment, programs, finances, rehearsal techniques, contests and festivals, materials, personnel selection and grades. 3 cr.

883. INSTRUMENTAL LITERATURE AND ITS PERFORMANCE

Exploration of representative solo and ensemble music for string, wind and percussion instruments. Typical literature from each period of Music is studied. As much as is possible, live performance is included, recordings used as required. Detailed attention given to interpretation. Project required. 3 cr.

884. CHORAL LITERATURE AND ITS PERFORMANCE

Analysis, discussion, and conducting of excerpts from choral masterpieces from all major periods and styles. Students will have opportunities to act as assistant conductors for some of the choral organizations on campus. Evaluation of current high school and college choral repertoires. 3 cr.

Physics (86)

Robert E. Houston, Jr., *Chairman*

For admission to graduate study in Physics the candidate must have satisfactorily completed undergraduate courses in Physics totaling 24 to 30 semester hours. Suitable undergraduate work in mathematics is essen-

tial and must include courses in differential equations and advanced calculus. The aim of the program is to give the student broad general training in fundamentals. Entering students will be expected to demonstrate proficiency in undergraduate work equivalent to that of the senior year in Physics at the University of New Hampshire. A placement examination, required of entering graduate students, will be given during the fall registration period.

The following courses are required for the Master's degree: Physics 831, 833, 841, and 843.

Candidates for the Master's degree must select one of the following two options:

- (a) Complete 24 course credits plus a thesis for 6 credits, and pass an oral examination on the thesis.
- (b) Complete 30 course credits and pass an oral examination on the 6 credits of course work substituted for a thesis.

All candidates for the Master's degree are expected to demonstrate proficiency in reading literature in one foreign language: German, French, or Russian. Requirements for the M.S. degree (see page 24) and further details may be obtained from the Department.

The following courses are required for the Ph.D. degree: Physics 831, 833, 835, 839, 841, 842, 843, 844, 863, and 865.

A candidate for the Ph.D. degree will be expected to show that he has a broad basic knowledge of the field of Physics and that he has acquired a sufficient understanding of a specialized area to begin a dissertation. To accomplish this all candidates must demonstrate an outstanding proficiency in undergraduate physics by passing with distinction the placement examination, which may be taken twice. A written and oral preliminary qualifying examination will be required of all candidates. These examinations must be taken before the end of four semesters. The final qualifying examination will consist of an oral examination based upon the student's area of concentration. The Ph.D. candidates will be expected to demonstrate proficiency in two languages by passing examinations in German, Russian, or French. The language requirement should be satisfied before taking the final qualifying examination. Requirements for the Ph.D. degree and further details may be obtained from the Department.

All graduate students must register for Physics 897-898 for two years.

Courses numbered between 600 and 699 may be taken for graduate credit by non-majors only.

607. PHYSICAL OPTICS

Maxwell's equations, the nature of light, interference, diffraction, polarization, and related phenomena. (Offered on request.) Prereq: Math. 527. 3 cr.

Physics

701. INTRODUCTORY QUANTUM MECHANICS

Quantum mechanics with application to atomic physics. Prereq: Phys. 503 and 704. 3 cr.

702. ATOMIC AND NUCLEAR PHYSICS

Magnetic moments, spin, identical particles, multielectron atoms, collision theory, and the nucleus. Prereq: Phys. 701. 3 cr.

703-704. ELECTRICITY AND MAGNETISM

Foundation of electromagnetic theory, including electrostatics, dielectric theory, electromagnetism, magnetic properties of matter, alternating currents. Maxwell's field theory, and an introduction to electrodynamics. 3 cr. ea.

831-832. MATHEMATICAL PHYSICS

Differential equations of physics, complex variables, orthogonal functions, variational methods, matrices, vector, and tensor analysis. 3 cr. ea.

833-834. EXPERIMENTAL PHYSICS

Modern research techniques, including discussion and laboratory exercises in fundamental measurements in optics, electromagnetism, nuclear, atomic, and molecular phenomenon. 1-3 cr. ea.

835. STATISTICAL PHYSICS I

A review of thermodynamics and kinetic theory, followed by an introduction to statistical thermodynamics. Prereq: Phys. 831 or permission of the instructor. 3 cr.

836. STATISTICAL PHYSICS II

Basic formulation and application of statistical mechanics to physical problems. Prereq: Phys. 840. 3 cr. (Offered on request.)

837. MATHEMATICAL PHYSICS

Formulation and solution of physical problems grouped according to their mathematical properties. Prereq: Phys. 831-832. 3 cr. (Offered on request.)

839. THEORETICAL MECHANICS

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies, with particular attention to those topics that serve as background for the study of modern physical theories. 3 cr.

841-842. ELECTROMAGNETIC THEORY

The formulation and detailed application of electromagnetic theory to physical problems. Prereq: Phys. 831 or permission of the instructor. 3 cr. (842 offered on request.)

843-844. QUANTUM MECHANICS

Wave mechanical and Dirac formulations of non-relativistic quantum mechanics. Recommended prereq: Phys. 701. 3 cr. each.

850. PLASMA PHYSICS I (HYDROMAGNETIC PHENOMENA)

Steady state conditions, hydromagnetic waves, turbulence, shock waves, and individual particle motion will be discussed. 3 cr.

852. PLASMA PHYSICS II

A description of Plasma Physics from the Kinetic Theory point of view. Recommended prereq: 835. 3 cr. (Offered on request.)

861-862. ADVANCED QUANTUM MECHANICS

Generalized formulation of quantum mechanics, formal scattering theory and introduction to relativistic theory. Field theory and related topics. Prereq: Phys. 839 and 844. 3 cr. ea.

863-864. NUCLEAR PHYSICS

Formulation of theory underlying current experiments. Prereq: Phys. 840. 3 cr. (Offered on request.)

865-866. SOLID STATE PHYSICS

Development of quantum mechanical theory of solids, transport, phenomena, etc. Prereq: Phys. 840 and 835. 3 cr. (Offered on request.)

887. INTRODUCTION TO SPACE SCIENCE

Detailed study of the earth and its physical environment, interplanetary medium, magnetosphere, the solar system and beyond. Prereq: Permission of instructor. 3 cr.

889-890. SPACE PHYSICS SEMINAR

Lectures and discussions of current research in the physics of fields and particles in space. 1-3 cr.

891, 892. PROBLEMS IN THEORETICAL PHYSICS

May be taken more than once. 3 cr. (Offered on request.)

893, 894. PROBLEMS IN EXPERIMENTAL PHYSICS

May be taken more than once. 3 cr. (Offered on request.)

895, 896. SPECIAL TOPICS

Any special fields of study not covered by the above courses may be included. Choice of topic to be determined by class. 1-3 cr. May be taken more than once.

897-898. COLLOQUIUM

Required of all graduate students. Topics to be selected. No credit.

899. MASTER'S THESIS

6 cr.

999. DOCTORAL RESEARCH

Plant Science

Plant Science (32)

Lincoln C. Peirce, Chairman

The graduate research program in Plant Science is concerned with solving basic and applied problems associated with production of horticultural or agronomic crops. Facilities include laboratories, field and greenhouse research areas, and plant growth chambers.

Program emphasis is directed toward breeding and genetics and toward crop physiology or biochemistry. Research and teaching in plant genetics, cytogenetics, and plant breeding is a major strength and is complemented by expanding University programs in statistics and in biochemical and microbial genetics. (See descriptions of Genetics Program.) Increased emphasis also is being given to research in plant metabolism, mineral nutrition, and growth and development. In certain instances, these research areas are integrated with the genetics projects to provide unique approaches toward solving agricultural problems.

It is recommended that all graduate students first complete work for the M.S. degree. Candidates for this degree will be required to pass an oral examination and will usually be required to prepare a thesis. Candidates for the Ph.D. degree, in addition to the general requirements, must also demonstrate a reading knowledge of two foreign languages and complete a thesis on original research. One or two minors may be required of Ph.D. candidates in fields closely related to the student's area of specialization.

704. ANNUAL CROPS

A study of annual grains, silage crops, and potatoes and their characteristics of growth as affected by culture and management. Mr. Higgins. 2 lec; 1 lab; 3 cr. (Alternate years; offered in 1967-1968.)

706. PASTURE-HAY CROPS

A survey of the important forage and pasture crops, their characteristics of growth, culture, and management. Mr. Higgins. Prereq: Bot. 411, Pl. Sci. 402. 3 lec; 1 lab; 4 cr. (Alternate years; not offered in 1967-1968.)

708. NUTRITION AND WATER RELATIONS

Mineral requirements of plants and response to deficiencies. Effect of soil and atmospheric environments on plant growth and differentiation of plant parts. Mr. Eggert. Prereq: 3 cr. Plant Physiology. 2 lec; 1 lab; 3 cr. (Offered in 1967-1968.)

753. FRUIT CROPS

The growth and management of tree and small fruit crops. Pest control, storage, marketing and response to pruning and grafting. Mr. Eggert. Prereq: 7 cr. Bot., Pl. Sci. 406; 7 cr. Soils. 3 lec; 1 lab; 4 cr. (Alternate years; not offered in 1967-1968.)

764. VEGETABLE CROPS

Systematic classification of vegetable crops, their use, management, and response to environment and competition in food and seed production. Mr. Peirce. Prereq: Bot. 411, Pl. Sci. 406 or equivalent. 3 lec, field trips, 3 cr. (Alternate years; not offered in 1967-1968.)

765. SYSTEMATIC POMOLOGY

Taxonomic relationships and group characteristics among varieties of tree and small fruits. Mr. Eggert. Prereq: 6-8 cr. Bot. 1 lec; 1 lab; 2 cr. (Alternate years; offered in 1967-1968.)

768. PLANT GROWTH AND DEVELOPMENT

Biochemical and physiological aspects of crop production. Bases for changes in growth or development of plants effected by environment or treatments. Mr. Eggert. Prereq: Chem. 545, Bot. 756 or equivalent. 3 cr. (Alternate years; offered in 1967-1968.)

774. METHODS AND THEORY OF PLANT BREEDING

History theory and use of plant breeding systems, including bulk and pedigree methods, recurrent selection, gamete selection and testing. Mr. Peirce. Prereq: 3 cr. in genetics. 3 cr. (Alternate years; offered in 1967-1968.)

795-796. INVESTIGATIONS IN PLANT SCIENCE

Selected topics for crop or library research. Prereq: Permission of instructor. 1-4 cr.

PLANT GROWTH AND DEVELOPMENT: Messrs. Eggert, Routley

BREEDING AND GENETICS: Messrs. Dunn, Peirce, Rogers

CROP PRODUCTION AND MANAGEMENT: Messrs. Higgins, Eggert, Peirce

ORNAMENTALS AND TURFGRASS: Messrs. Higgins, Rogers

851. PLANT GENETICS

Linkage, euploidy, aneuploidy, cytoplasmic inheritance, mutation and genetics of disease resistance. Mr. Dunn. Prereq: 3 cr. Genetics. 3 cr. (Alternate years; not offered in 1967-1968.)

853. CYTOGENETICS

Chromosome aberrations and their behavior. Effect of radiation on chromosomes. Mapping and laboratory technique in cytogenetic analysis. Mr. Rogers. Prereq: 3 cr. each of Genetics and Cytology. 2 lec; 1 lab; 3 cr. (Alternate years; not offered in 1967-1968.)

895-896. RESEARCH IN PLANT SCIENCE

Selected topics involving library study and greenhouse, growth chamber or field research. 1-4 cr.

1. **GROWTH AND DEVELOPMENT:** Messrs. Eggert, Routley

2. **BREEDING AND GENETICS:** Messrs. Dunn, Peirce, Rogers

3. **CROP PRODUCTION AND MANAGEMENTS:** Messrs. Higgins, Eggert, Peirce

4. **ORNAMENTALS AND TURFGRASS:** Messrs. Higgins, Rogers

Plant Science

897-898. GRADUATE SEMINAR

Library research in current topics of Plant Science. Practice in presentation of reports. Required of all graduate students majoring in Plant Science and open to related departments. Staff. 1 cr.

899. M.S. THESIS

A thesis study of some phase of Plant Science is usually required of candidates for an advanced degree. 6-10 cr.

999. PH.D. THESIS

Candidates must complete a thesis on original research in Plant Science.

Political Science (52)

Robert B. Dishman, *Chairman*

A candidate for the degree of Master of Arts in Political Science must complete 30 credits: 18 credits in Political Science courses numbered 800-899, including six credits for the thesis, and 12 credits in courses in related fields. The candidate must pass a written examination covering three fields in Political Science agreed upon between the student and his adviser.

The Political Science Department offers a Master of Public Administration degree designed for individuals intending to pursue a career in administration. Candidates must complete 30 credits: 9 credits dealing with the process of administration; 12 credits in statistics, public finance, personnel administration and research in government problems; and the balance selected to suit the candidate's particular interest.

Candidates for the M.P.A. without experience in governmental administration are expected to serve a three- to six-month internship in an agency of their choosing. The candidate shall submit an analytical appraisal of this activity. Experienced public employees are expected to submit a similar report about the agency with which they are most familiar.

715. COMPARATIVE POLITICS

Concepts of government and politics dealing with political dynamics, institutions, and change in developed and under-developed areas by use of the comparative method. Mr. Wurzburg. 3 cr.

717. CONTINENTAL EUROPEAN POLITICAL PARTIES

The relationship of theories of representation and political parties to historical circumstance. Following an appraisal of today's party systems, chronological treatment serves to show how changes within and among political parties are connected with the changing role parties play in the

political process. Mr. Wurzburg. Prereq: Permission of the Department. 3 cr.

726. PRESSURE GROUPS AND THE GOVERNMENT PROCESS

Political interest groups as an unofficial "third house" of American national and state legislatures. The efforts by pressure groups to influence public officials by lobbying, propaganda, and direct political action. Mr. Ford. Prereq: Gov. 406. 3 cr.

727. THE AMERICAN POLITICAL EXECUTIVE

The behavior of the American President and other political executives in the formulation and execution of policy. The relation of political executives to the legislature, the courts, and the bureaucracy. Public opinion, groups, and voting behavior and the problem of executive political leadership and power. The role of the political executive in democratic political systems in modern times and the prospects for the future. Mr. Craig. 3 cr.

728. LEGISLATIVE BEHAVIOR AND THE UNITED STATES CONGRESS

The role of Congress and legislative behavior in the American political system. The organization, operation and process of legislating. The personnel and informal rules of the legislative process. The influence of groups, public opinion, elections and decision-making agencies on the legislative policy-making process. The analysis of proposed reforms of legislatures. The functions of legislative policy-making in democratic political systems. Mr. Craig. 3 cr.

731. THE ADMINISTRATIVE PROCESS

The principal concepts of governmental administration, including theories of organization, administrative leadership, internal management, and administrative responsibility and control. The relationship of group behavior and policy development to the administrative process. Prereq: Gov. 406 or Soc. 400. 3 cr.

736. URBAN GOVERNMENT AND POLITICS

The role of government in the planning and managing of the urban community, as well as the political problems of the metropolitan complex will be considered. Metropolitan planning will be treated in relation to zoning, land use, open space preservation, and transportation. The administrative functions to be studied include welfare, health, urban renewal and police protection. Mr. O'Connell. 3 cr.

741. ADMINISTRATION OF JUSTICE

A comparative study from primitive times to the present of the administration of criminal and civil justice under various legal institutions and systems. The modern role of the police, public prosecutor, judge, jury, counsel, and interest groups in the judicial process in the United

Political Science

States and in other nations, including England and Wales, France, Germany, and the Soviet Union. Mr. Dishman. 3 cr.

742. THE SUPREME COURT AND THE AMERICAN CONSTITUTION

The Supreme Court considered as both a court of law and a political institution. The origins and development of judicial review and changing conceptions of the judicial process. The Supreme Court as supreme arbitrator in disputes between the nation and the states, the President and Congress, and majority rule and minority rights. Mr. Dishman. Prereq: Gov. 406 or permission of the instructor. 3 cr.

745. WORLD POLITICS

The basic driving forces in international relations, including the nature of political power and its extension or limitations. Geopolitics, nationalism, ideology, imperialism, international economic relations, balance of power, warfare, regulation of arms, international law, and collective security. Mr. Holden. 3 cr.

746. FOREIGN POLICIES OF THE GREAT POWERS

Fundamental factors influencing contemporary foreign policy formulation in the United States, the Soviet Union, the British Commonwealth, and other significant powers. Problems and choices confronting policy makers of these powers in dealing with issues involving the United Nations, regional organizations, Western Europe, Middle East, and Asia. Mr. Holden. 3 cr.

751. CONTEMPORARY SOUTHEAST ASIA

A comparative study of the political and social development of Southeast Asia. The significance of the role of independence and dependence; the competing influence of communism and Western democracy; the special significance of the role of China, India, Great Britain, and the United States. The states to be studied include the Philippines, Laos, Cambodia, Viet Nam, Thailand, Burma, Malaysia, and Indonesia. Mr. Holden. 3 cr.

752. GOVERNMENTS OF EMERGING COUNTRIES

A comparative study of recent developments in the politics and governing systems of Asia and Africa, and regional arrangements indigenous to these areas. Prereq: Gov. 405 or permission of instructor. 3 cr.

754. GOVERNMENTS OF LATIN AMERICA

A comparative study of the politics and government systems of Latin America with some consideration given to regional arrangements. Pre-req: Gov. 405 or permission of instructor. 3 cr.

756. CONTEMPORARY SOUTH ASIA

A comparative and analytical study of the historic, political, social and economic influences in modern South Asia. Special attention will be paid to the rivalries between Pakistan and India, to the pressures of the

Soviet, the United States and China; to the influences of both the Commonwealth and the Afro-Asian bloc ideals and goals. The states to be included are Pakistan, India, Ceylon, Nepal and Afghanistan. Mr. Holden. 3 cr.

757. GOVERNMENT AND POLITICS OF CHINA

A brief but intensive historical background is followed by an analysis of recent developments in the field of government, parties, and ideologies of China. Course concludes with a survey of recent developments in international relations and foreign policy relevant to the country considered. Mr. Woodruff. 3 cr.

758. GOVERNMENT AND POLITICS OF JAPAN

A brief but intensive historical background is followed by an analysis of recent developments in the field of government, parties, and ideologies of Japan. Course concludes with a survey of recent developments in international relations and foreign policy relevant to the country considered. Mr. Woodruff. 3 cr.

763. POLITICAL THOUGHT IN THE WEST

The principal political theories from Plato and Aristotle to the beginning of the modern liberal tradition. The growth and development of political thinking and institutions in terms of the development of modern government. The development of the modern nation state and its fundamental institutions. Mr. Jaffe. 3 cr.

764. MODERN POLITICAL THOUGHT

Modern Western political thought from the emergence of the nation state to the present. The meaning and growth of the basic patterns of thought on the Continent and in England, including liberalism, democracy, nationalism, socialism, communism, and facism. The contributions of American political thought as it grew from its English origins to the development of the American constitutional system. Mr. Jaffe. 3 cr.

765. CONTEMPORARY POLITICAL THEORY

A survey and analysis of contemporary political theories. The crisis in democratic thought, totalitarian ideology, the search for scientific political theory. Prereq: Gov. 763, 764 or permission of instructor. 3 cr. Mr. Jaffe.

771, (771). RESEARCH IN GOVERNMENT PROBLEMS

Independent study of the methods and techniques of research in various fields of government. Students analyze the economic, social, and political structure of their own community, the composition and organization of their state legislature, the record of their Representative in Congress or one of their Senators, the legislative history of an act of Congress

Political Science

and the judicial process as exemplified by a decision of the U. S. Supreme Court. Students not writing a profile of their home community will be expected to write an extended thesis on some topic of their choice in any field of political science. Open to junior majors in government and others with permission of the instructor. 3 cr.

775. INTERNATIONAL LAW

The theory and practice of international law and its relation to the international community of nation-states and international organizations. Also, the function of law in international relations as analyzed from decisions of national and international tribunals and as manifested in constitutions, charters and other international documents. Mr. Larson. Permission of the instructor. 3 cr.

776. INTERNATIONAL ORGANIZATION

The theory of collective security and cooperation and the practice of international organizations as a response to meeting the needs of the international community. Emphasis will be placed upon the League-United Nations System and specialized regional organizations. Mr. Larson. Prereq: 765 or permission of the instructor. 3 cr.

779. PUBLIC POLICY AND REGIONALISM

3 cr.

795, 796. SELECTED TOPICS IN POLITICAL SCIENCE

This course number will be used for special courses that are not regularly offered. 3-6 cr.

797, 798. SEMINAR IN GOVERNMENT

A selected current topic from government, political philosophy and history, political behavior, public law, public administration, or international relations. Each student is held responsible for a specific phase of the selected problem. He will also, through the techniques of the seminar, acquaint himself with the whole project. Restricted to undergraduates with honor grades and graduate students in Social Science. Advance copies of the syllabus may be secured from the Department Chairman. Permission of the instructor is required. Mr. Holden, Mr. Dishman, Mr. Jaffie, Mr. Ford, Mr. Larson, and Mr. Wurzburg. 3 cr.

READING AND RESEARCH IN GOVERNMENT AND POLITICAL SCIENCE

With the advice and consent of the instructor, graduate students in social science who demonstrate the ability to do independent work may register for the following reading and research courses. The student will attend the regular lectures, meet the required examinations, follow a prescribed reading program, and write a paper in lieu of a final examination.

815. COMPARATIVE POLITICS

Mr. Wurzburg. 3 cr.

817. CONTINENTAL EUROPEAN POLITICAL PARTIES

Mr. Wurzburg. 3 cr.

826. PRESSURE GROUPS AND THE GOVERNMENTAL PROCESS

Mr. Ford. 3 cr.

827. THE AMERICAN POLITICAL EXECUTIVE

Mr. Craig. 3 cr.

828. LEGISLATIVE BEHAVIOR AND THE UNITED STATES CONGRESS

Mr. Craig. 3 cr.

831. THE ADMINISTRATIVE PROCESS

3 cr.

832. COMPARATIVE ADMINISTRATION

3 cr.

833. AMERICAN NATIONAL, STATE, AND LOCAL ADMINISTRATION

This generally follows Gov. 831, The Administrative Process, and deals with various specialized aspects of administrative practice in the United States, including policy formation in administrative settings, rule making, administrative adjudication, and policy control. Selected staff. 3 cr.

834. ADMINISTRATIVE DECISION-MAKING

3 cr.

836. URBAN GOVERNMENT AND POLITICS

Mr. O'Connell. 3 cr.

841. ADMINISTRATION OF JUSTICE

Mr. Dishman. 3 cr.

842. THE SUPREME COURT AND THE AMERICAN CONSTITUTION

Mr. Dishman. 3 cr.

845. WORLD POLITICS

Mr. Holden. 3 cr.

846. FOREIGN POLICIES OF THE GREAT POWERS

Mr. Holden. 3 cr.

851. CONTEMPORARY SOUTHEAST ASIA

Mr. Holden. 3 cr.

852. GOVERNMENTS OF EMERGING COUNTRIES

3 cr.

854. GOVERNMENTS OF LATIN AMERICA

Mr. Larson. 3 cr.

856. CONTEMPORARY SOUTH ASIA

Mr. Holden. 3 cr.

Political Science

857. GOVERNMENT AND POLITICS OF CHINA
Mr. Woodruff. 3 cr.
858. GOVERNMENT AND POLITICS OF JAPAN
Mr. Woodruff. 3 cr.
863. POLITICAL THOUGHT IN THE WEST
Mr. Jaffe. 3 cr.
864. MODERN POLITICAL THOUGHT
Mr. Jaffe. 3 cr.
865. CONTEMPORARY POLITICAL THEORY
Mr. Jaffe. 3 cr.
875. INTERNATIONAL LAW
Mr. Larson. 3 cr.
876. INTERNATIONAL ORGANIZATION
Mr. Larson. 3 cr.
879. PUBLIC POLICY AND REGIONALISM
3 cr.
- 895, 896. SELECTED TOPICS IN POLITICAL SCIENCE
3-6 cr.
- 897, 898. SEMINAR IN GOVERNMENT
Mr. Holden, Mr. Dishman, Mr. Jaffe, Mr. Ford, Mr. Larson, and Mr. Wurzburg. 3 cr.
899. MASTER'S THESIS
6-9 cr.

Psychology (67)

Raymond L. Erickson, *Chairman*

The Department of Psychology offers a program of study leading to the Ph.D. degree. The doctoral program is specifically designed to prepare psychologists who plan to become college or university teachers. Its major goal is the development of competent general psychologists who have attained depth in a special area and who are capable of extending knowledge through research. In addition, however, a concern with other specific needs of the psychologist who intends to become a college or university teacher is woven into the entire program. In the third year, the student will have the opportunity to teach a small section of introductory psychology under close supervision of the staff and will be enrolled in a

teaching seminar that has among its goals a deepening of the student's appreciation of the objectives and problems of teaching in the liberal arts.

The student's Guidance Committee will counsel with him to help plan an effective graduate program, which will typically require four years. In addition to the areas stressed in the core training shared by all students, i.e., methodology and statistics, history, theory, and systems in psychology, and teaching and the communication process, each student's program will include an emphasis upon psychobiological and psychosocial themes. To this end, work outside the department may be recommended when appropriate. Depth in a particular area may be obtained by independent study and research conducted under the supervision of a staff member, as well as by participation in the graduate offerings listed in Group II below. Psychol. 895, 896, Reading and Research in Psychology, is specifically designed to serve this purpose.

Prior to his doctoral dissertation, the student will carry out original research that culminates either in a master's thesis or a paper of publishable quality. A Master's degree may be awarded as part of the student's program. Detailed information concerning language requirements and the qualifying examination for advancement to candidacy for the Ph.D. can be obtained from the department.

A student admitted to graduate study must meet the requirements for admission to the graduate school. In applying for admission to the department's program, he must submit Graduate Record Examination scores on the Verbal and Quantitative sections of the Aptitude Test and his score on the Advanced Test in Psychology.

To be accepted into the program, the applicant must desire to pursue the Ph.D. degree and be deemed qualified to do so on the basis of initial selection procedures. He need not necessarily have been an undergraduate major in psychology. However, before beginning his graduate career proper, he must have completed a minimum of 15 undergraduate credits in psychology, including courses in elementary statistics, experimental psychology, learning theory, and systematic psychology.

Preference in admission will be given to those who have recently received their bachelor's degree. Only under unusual circumstances will admission be granted to applicants who already hold a master's degree.

Graduate Curriculum in Psychology

The courses and seminars listed below provide the general framework within which the student will develop, with the counsel of his Guidance Committee, his program of research and study leading to the Ph.D. degree. The range and sequence of seminars will vary to some extent with each student, though there will be common features to all programs.

Psychology

The 700 series courses are not normally taken for graduate credit, though a student may be advised to enroll in one of these courses as a way of improving his background in the field. Graduate credit for a 700 series course is permitted only with the previous approval of the student's adviser.

744. THEORIES OF PERSONALITY

The major theories of personality, with an examination of clinical and research literature as it is related to the nature and development of personality. Mr. Jervis. Prereq: Psych. 402. 3 cr.

754. ABNORMAL PSYCHOLOGY

A systematic examination of abnormal behavior patterns. The neuroses, psychoses, and character disorders are considered in detail, in terms of their etiology, symptoms and dynamics, and treatment. Mr. Sibley. Prereq: Psych. 402. 3 cr.

758. PSYCHOLOGY OF LEARNING

An evaluation of contemporary theories of learning. Attention is given to the historical antecedents of current theories, their experimental support and practical implications. Mr. Haslerud, Mr. Erickson. Prereq: Psychol. 402. 3 cr.

760. PSYCHOLOGY OF MOTIVATION

Motivational constructs are studied in relation to contemporary theories of behavior. The role of motivational variables is considered in relation to such other areas of psychology as learning, perception, and personality. Mr. Rutledge. Prereq: Psychol. 402. 3 cr.

776. COMPARATIVE PSYCHOLOGY

Appraisal of the similarities and differences in the behavior of infra-human organisms as an aid to understanding the evolution of complex behavior. The comparative method is applied to the study of such topics as instinct, consciousness, reasoning, judgment, social influence, and abnormal behavior. Mr. Hagstrom. Prereq: Psychol. 402. 3 cr.

778. PHYSIOLOGICAL PSYCHOLOGY

A study of behavior as it is related to the physiological structure and function of the organism. Special attention is given to sensory, neural, and glandular functions as organic bases for factors such as motivation, emotion, and learning. Mr. Hagstrom. Prereq: Psychol. 402. 3 cr.

780. SOCIAL PSYCHOLOGY

A consideration of the social factors affecting perceptual-cognitive processes, learning, motivation, and the behavior of man in the social system. Mr. Haaland. Prereq: Psychol. 402. 3 cr.

783. SYSTEMATIC PSYCHOLOGY

An evaluation of the numerous approaches to the study of behavior

that exist within contemporary psychology. Historical perspective is given by attention to the major antecedents in philosophy, theology, and the physical sciences, and their relationship to the subsequent development of schools and systems of psychology. Mr. Watson. Prereq: Psychol. 402. 3 cr.

789. SPECIAL TOPICS IN PSYCHOLOGY

Taught by a different staff member each year. The instructor will present advanced material in an area in which he has developed specialized knowledge through research and special study. Students may repeat the course, but may not duplicate areas of specialization. Staff. Pre-req: 15 cr. in psychology and/or permission of instructor. 3 cr.

Graduate Seminars in Psychology

GROUP I (TO BE TAKEN BY ALL FIRST YEAR STUDENTS.)

801-802. GRADUATE PROSEMINAR

Students and graduate faculty in psychology meet every two weeks for a mutual exchange on current issues in psychology. No credit.

803-804. HISTORY, THEORY, AND SYSTEM IN PSYCHOLOGY

An intensive consideration of the nature of science, directed toward increasing the student's awareness of both the strengths and limitations of the approach that characterizes psychology as a behavioral science. Attention is given to the philosophical bases upon which psychological research rests, the nature of psychological inquiry, the history of the study of behavior, and the evolution of theory building in psychology. Mr. Watson. 3 cr.

809-810. RESEARCH METHODOLOGY AND STATISTICS I, II

A consideration of research techniques and methodology in psychology. The first two semesters stress statistical and design problems, considering such topics as probability theory, the theory underlying statistical inference, parametric and non-parametric tests of significance, analysis of variance, and the appropriate use of various basic and complex designs. The multivariate techniques of multiple regression and discriminant analysis are examined. Prereq: Psychol. 567 and 568 or their equivalents. Mr. Ghei. 3 cr.

811. RESEARCH METHODOLOGY AND STATISTICS III

A continuation of Psychol. 809-810 covering such topics as survey research, field studies, content analysis and the relationship between research methodology and the philosophy of science. Mr. Ghei. 3 cr.

GROUP II

815. DEVELOPMENTAL PSYCHOLOGY

A study of the genesis and development of behavioral and psychological

Psychology

processes as they contribute to an understanding of: (1) general behavior theory; and (2) the individual at various stages of development. The antecedents, the contemporary determinants, and the process of behavior change are investigated through the examination of selected developmental theories. The current problems and methods of research in psychological development are considered. Mr. Duryea. 3 cr.

820. MEASUREMENT AND ASSESSMENT

A seminar devoted to a consideration of the assessment of inter-individual and intra-individual variables as they operate in the functioning person. Attention is given both to basic problems of scientific measurement and to particular problems of measurement in psychology. In the latter category, topics covered include problems encountered in attitude scaling and in measuring intelligence and personality. 3 cr.

835. ADVANCED PSYCHOPATHOLOGY

The current literature is utilized to gain perspective on the etiology and dynamics of the major forms of pathological behavior. Various theoretical orientations are examined with regard to their implications for the psychotherapeutic process. Mr. Sibley. Prereq: Psychol. 754 or its equivalent, or permission of the instructor. 3 cr.

836. COGNITIVE PROCESSES

A study of the more complex processes that characterize man. Concept formation, problem solving, creative thinking, and the relationship between cognition and effective behavior are among the topics examined in depth. 3 cr.

838. THEORIES OF BEHAVIORAL CHANGE

An examination of Man's behavior in the process of problem-defining and problem-solving. Recognizing that solutions to problems are based on the definitions of problems, the course examines the process by which problems are defined. The essential nature of functional fixedness or set in problem-solving is examined in relation to insight and creativity. The defining and solving of problems is related to changes in the individual, the organization, and the nation. The course recognizes that Man's experiences and his actions are the result of how he defines and attempts to solve problems. Mr. Jervis. 3 cr.

841. PERSONALITY THEORY

A critical examination of the evolutionary development of the major personality theories, with particular reference to the theoretical, clinical, and experimental contributions to current theories. Mr. Jervis. 3 cr.

843. PSYCHOLINGUISTICS

A critical examination of issues relevant to the development, structure and functions of language. Topics include the problem of meaning, ac-

quisition of grammar by the child, personality and voice, and the interrelationship of language and culture. Mr. Sibley. 3 cr.

851. ADVANCED SOCIAL PSYCHOLOGY

A seminar devoted to the study of theoretical and experimental support for major topics of current concern. These may include attitude change, power, interpersonal perception and attraction, roles, interaction, and analysis of structure and function in complex social systems. Mr. Haaland. Prereq: Psychol. 780 or its equivalent. 3 cr.

862. PSYCHOLOGY OF PERCEPTION

A study of experiments and theory concerning the organism's discrimination and interpretation of its apparent environment. An examination is made of perceptual models in learning and other areas of psychology. The course culminates in independent perceptual experiments carried out individually by each student. Mr. Haslerud. 3 cr.

865. ADVANCED PHYSIOLOGICAL PSYCHOLOGY

A seminar devoted to an intensive examination of specific topics relating behavior to its physiological correlates. Among the topics considered are receptor functions, cortical mechanisms, memory, neural correlates of drive states, emotional behavior and intracranial stimulation. Mr. Hagstrom. Prereq: Psychol. 778 or its equivalent. 3 cr.

868. EVALUATION OF THE THERAPEUTIC PROCESS

The process of psychotherapy is examined in relation to relevant research findings. The role of the psychotherapist's working theory is made explicit by showing its effect upon inferences made, goals set, and methods employed in changing the client. The student learns methods of evaluating various theoretical positions, including the identification of basic assumptions that underlie them. He is encouraged to identify the basic assumptions upon which he bases his own theoretical position. Mr. Jervis. 3 cr.

870. ADVANCED PSYCHOLOGY OF LEARNING

An intensive study of problems in conditioning and other forms of learning. Emphasis is given to the evaluation of current experimental and theoretical literature. Mr. Rutledge. Prereq: Psychol. 758 or its equivalent. 3 cr.

GROUP III

891-892. SEMINAR AND PRACTICUM IN THE TEACHING OF PSYCHOLOGY

A consideration of typical problems encountered in teaching psychology on the college level, including an examination of the implications of the liberal arts philosophy for teaching. Under close supervision of the staff, the student will be given an opportunity to teach an undergraduate section of introductory psychology. The seminar and practicum operate

Psychology

in close coordination throughout the year. Required of all doctoral students, typically during the third year. Mr. Erickson. 5 cr.

895, 896. READING AND RESEARCH IN PSYCHOLOGY

As part of his development as an independent scholar, the student is encouraged to plan: (1) broad reading in an area; or (2) intensive investigation of a special problem; or (3) experimental testing of a particular question. The project may involve library research, empirical research, or both. Registration must be acceptable to the student's Guidance Committee and to the staff member who has agreed to serve as his adviser on the project. May be repeated. Staff. 3-6 cr. per semester.

897, 898. PROBLEMS AND ISSUES IN PSYCHOLOGY

A seminar to be offered by one or more members of the staff concerning problems and issues of special importance in the current development of the field. On occasion the seminar will feature a problem which has been the subject of specialized research and study by a member of the staff. The personnel and topical focus will vary from year to year, and the course may be repeated by the student. Staff. 3 cr.

899. MASTER'S THESIS

Each student will carry out original research that culminates either in a master's thesis or a paper of publishable quality. 6 cr.

999. DOCTORAL RESEARCH

GROUP IV (GRADUATE COURSES OFFERED PRIMARILY FOR STUDENTS ENROLLED IN OTHER GRADUATE PROGRAMS)

822. CASE STUDIES IN COUNSELING

Case studies are used to illuminate the differences among a variety of personality theories and counseling techniques. The seminar is designed to help develop an appreciation of the complexities of human behavior, to gain increased respect for the integrity of individuals and their difficulties in revealing themselves to a counselor, and to understand better the difficulties encountered in applying theoretical knowledge to the counseling situation. Mr. Carroll. 3 cr. (Offered only in the summer.)

823. INDIVIDUAL TESTING

Training in the administration, scoring, and interpretation of individual tests of intelligence. Such instruments as the Wechsler Adult Intelligence Scale, the Stanford-Binet, and the Wechsler Intelligence Scale for Children will be critically analyzed. Each student will be required to purchase one set of test materials. Miss Riggs. Prereq: Permission of the instructor. (Adequacy of the student's background in statistics, measurement, and personality theory will be evaluated by the instructor.) 1 lec; 1 lab; 4 cr.

Resource Economics (21)

James R. Bowring, *Acting Chairman*

Admission to graduate study in Resource Economics may be granted those who have satisfied the requirements for admission to the Graduate School and present evidence of satisfactory undergraduate training. Normally this will include nine or more credits in Economics, including Resource or Agricultural Economics, as evidence of aptitude for advanced training in the field. Candidates for the Master of Science degree will be required to pass a final examination. An acceptable thesis is normally a requirement for the degree, but approved course work may be substituted for the thesis.

706. ECONOMICS OF RESOURCE DEVELOPMENT

Some of the classical and modern theories of economic development. Economic problems of land and resources in relation to market location, urban-rural conflicting demands, and conservation and water supply. Population mobility, capital needs, and the roles of public and private leadership will complete the framework for discussion of the major resource development problems of New England. Mr. Bowring. Prereq: Eco. 401. 3 cr.

708. RESEARCH METHODS IN SOCIAL SCIENCES

Designed to teach the scientific method of research to advanced students. The meaning of logic and the scientific method and the application of research techniques to identifying and solving problems. Prereq: 3 hours of statistics. Mr. Drew. 3 cr.

711. PUBLIC POLICY FOR AGRICULTURE

Problems which are the basis for government and private policies in the production and marketing of agricultural products. Prices, production controls, marketing agreements, conservation, and credit are appraised relative to the objectives of the economy and the concept of general welfare. Mr. Drew. 3 cr.

715. LINEAR PROGRAMMING METHODS

Setting up and solving problems by the simplex and distribution methods; variation in linear programming methods with applications, non-linear programming, discrete programming, and solving input-output and game theory problems. Applications to firm and aggregate economic analysis. Prereq: Math. 407 or permission of instructor. Mr. Andrews. 3 cr.

795-796. INVESTIGATIONS IN RESOURCE ECONOMICS

Special assignments in readings and problems to satisfy the student's needs. Mr. Andrews, Mr. Bowring, Mr. Christensen, Mr. Drew, Mr. Forste, Mr. LeRay, and Mr. Henry. 1-3 cr.

Resource Economics

804. ECONOMICS OF PRODUCTION AND RESOURCE USE

Principles of choice, resource use, and production under perfect and imperfect knowledge. The economic theory of resource allocation and the use of this theory in problem solving. Resource-product relationships, nature of cost, returns to scale, factor valuation and pricing, uncertainty, and interfirm relations. Mr. Andrews. 3 cr.

807. STATISTICAL ANALYSIS

Statistical measurement and research tools for use in the physical and social sciences. Regression, analysis of variance, factorial analysis, covariance, time series, sampling and experimental design. Mr. Bowring. 3 cr.

809. AGRICULTURAL ECONOMICS

Analysis of supply, demand, and price relationships. Appraisal of the economic theory relevant to decision-making in food production, marketing, and consumption, and on the competitive structure of the food industry. Mr. Henry. 3 cr.

895-896. INVESTIGATIONS IN RESOURCE ECONOMICS

With the advice and consent of the instructor, a student, prepared by training and experience to do independent work, may register for a reading and research course. The student will undertake assigned problems and readings under guidance of the instructor. Mr. Andrews, Mr. Bowring, Mr. Christensen, Mr. Drew, Mr. Forste, Mr. LeRay, and Mr. Henry. 1-3 cr.

897-898. SEMINAR IN AGRICULTURAL AND RESOURCE POLICY

Presentation and discussion of reports on public policy issues associated with agriculture and resource development. Departmental staff. May be repeated. 1 cr.

899. THESIS

To be arranged. 6-10 cr.

Social Science (45)

893, 894. INTERNSHIP IN COLLEGE TEACHING

Limited to Ford Foundation Scholars. Each student will be responsible for teaching one section of introductory courses in his major department in the Social Science division. This teaching will be done under faculty supervision. In addition, students will attend bi-weekly seminars designed to acquaint them with the various aspects of the college teaching profession. 3 cr.

Sociology (68)

Stuart Palmer, Chairman

Admission to graduate status in the Department of Sociology is granted to the student who meets the entrance requirements of the Graduate School, and who has passed a comprehensive examination in sociology which is prepared by the members of the Department. This examination may be taken, under appropriate supervision, at a time and place which is convenient to the candidate. In the case of a student with an exceptionally strong undergraduate record, the examination may be waived.

In addition to having fulfilled the general requirements, the successful candidate for the Master of Arts degree in sociology will have completed a thesis written in one of the following fields: criminology, cultural anthropology, mass communications, medical sociology, minority group relations, population, rural sociology; the small group, social movements, social stratification, social theory, and urban sociology. It is expected that competence in both method and theory will be demonstrated in the thesis. No more than nine semester hours' credit in other departments will be accepted. No general oral or written examination is required.

701. STATISTICS

Use of elementary statistical techniques in analysis of prepared data. Topics include probability, discrete and continuous probability distribution, distributions of sample statistics, small sample theory, elementary analysis of variance, regression, correlation, and the chi square. 3 cr.

702. QUANTITATIVE METHODS OF SOCIAL RESEARCH

Analysis of research problems; designing field studies and experiments; demonstration and practice in sampling, schedule construction, and interviewing techniques. Students not majoring in Sociology nor enrolled in Social Service Curriculum may be admitted by permission of instructor. Prereq: Soc. 701. 3 cr.

703, (703). CRIMINOLOGY

The scientific study and control of crime. The following are considered: indexes, rates and theories of crime and delinquency, police, courts, probation, prison and parole. 3 cr.

711, 712. DEVELOPMENT OF SOCIOLOGICAL THEORY

Social thought from Plato to the present. First Semester: the works of selected individuals from Plato to Comte. Second Semester: the 19th Century European social philosophers; the ideas of U. S. social scientists, especially their contributions to present day sociological thought. Students not majoring in Sociology may be admitted by permission of the instructor. 3 cr.

Sociology

727. PUBLIC POLICY IN SOCIAL AND LABOR LEGISLATION

This course will cover American social and labor legislation of the recent decades and provide an opportunity to study the way in which American economic and human values have been implemented and modified by law. Attention will be given to legislation and private industry programs in social security, reemployment, unemployment insurance, health services, training and retraining and fair employment practice. The course will include lectures, discussion, assigned reading and individual student projects. Prereq: One year's work in economics or sociology. 3 cr. (Also offered as Eco. 727.)

740. CULTURE CHANGE

The study of various types of society leading to the development of a theory of culture change. Descriptive studies of institutional as well as theoretical materials selected from the writing of Comte, Marx, Spencer, Durkheim, Spengler, Sorokin, Redfield, and others. Prereq: Soc. 400 or consent of instructor. 3 cr.

743. SOCIAL MOVEMENTS

The factors related to the origin and development of reforms, revolutionary, religious, and other social movements. Generalizations concerning the organizations, structure, tactics, and leadership of social movements. The purposes and consequences of selected movements, as well as the relationships between social movements and social change. Pre-req: Soc. 400. 3 cr. (Not offered in 1967-1968.)

745. SOCIAL STRATIFICATION

Nature, functions, patterns, and effects of social stratification. Social mobility. The social class system in the United States. Prereq: Soc. 400. 3 cr.

755. ETHNOGRAPHY OF SOUTHEAST ASIA

A study of the geographical, racial, cultural, and historical factors in the development of the area, together with detailed examinations of selected peoples and aspects of their cultures. Prereq: Soc. 411 or permission of instructor. 3 cr.

761. POPULATION DYNAMICS

Examination of major population trends including changes in birth and death rates, population characteristics, mobility, migration, world population growth, population problems and policies of countries at different stages of economic development. Emphasis is on the interrelationship of population and society. 3 cr.

770. CULTURE, PERSONALITY, AND SOCIETY

Emergence of personality from the matrix of genetic, situational, and sociocultural determinants viewed in cross-cultural perspective; dyn-

amic interplay of the sociocultural and psychological behavioral systems.
Prereq: Permission of instructor. 3 cr.

815. CRIMINOLOGY INTERNSHIP

A four-month, three-quarter time, paid internship in a correctional institution. Consists of various types of routine correctional work and of the execution of small research projects as requested by the director of the prison or reformatory. Opportunity for thesis research in this setting is available. Required for Master of Arts in sociology with specialization in criminology. No credit.

821. DEVIANT BEHAVIOR

A seminar in which attention is directed to the relationships among cultural, subcultural, and personality variables and deviant behavior. Special emphasis is placed on the following forms of deviant behavior: invention, crime, alcoholism, and emotional illness. 3 cr.

830. THE SMALL GROUP

This course will examine the small group as a unit for sociological study, for the testing and the developing of hypotheses. Both the behavioral and the attitudinal levels shall be considered with respect to group intra-action and group-to-group interaction. The effects of different independent variables upon group structure shall be of particular interest. 3 cr.

852. SOCIALIZATION AND ABNORMAL BEHAVIOR

A seminar concerned with socialization and the effects of socialization on abnormal behavior. A survey of those orientations that relate socialization to abnormal behavior with the aim of synthesizing the major concepts into current sociological and social psychological frames of reference. In addition, emphasis will be placed on the methodological problems of research concerned with socialization with the objective of designing empirical research where socialization is the independent variable and abnormal behavior the dependent variable. Prereq: At least one course in social psychology or consent of instructor. 3 cr.

854. SOCIOLOGY OF RELIGION

Critical analysis of the reciprocal relationship of religion and culture; the function of religion in society; the contributions of sociological research; the relationship between religion and other social institutions; religion and social change and the problem of church and state. 3 cr.

861. DEMOGRAPHY

Survey and analysis of current problem areas in demography including: fertility, mortality, migration, population growth, population theory, formal demography, and the use of demographic sources and techniques in sociological investigation. Prereq: Introductory undergraduate course in demography or permission of instructor. 3 cr.

Sociology

871. SOCIAL INSTITUTIONS OF LATIN AMERICA AND THE CARIBBEAN

Selective analysis of distinctive institutions and social systems, with particular attention to social aspects of the process of modernization. Prereq. Consent of the instructor. 3 cr.

895, 896. READING AND RESEARCH IN SOCIOLOGY AND ANTHROPOLOGY

A student prepared by training and experience to do independent work under the guidance of an instructor may register for one or more of the following sections: (1) Communications, (2) Criminology, (3) Cultural Anthropology, (4) Culture Change, (5) Culture and Personality, (6) Deviant Behavior, (7) Ethnology, (8) Population, (9) Rural-Urban, (10) Social Control, (11) Social Differentiation, (12) Social Movements, (13) Social Psychology, (14) Social Research, (15) Social Theory. Prereq: 12 hours of sociology and consent of instructor. Hours and credit to be arranged.

897, 898. SPECIAL TOPICS SEMINAR

Under the direction of members of the Department on the basis of rotation and interest, seminars are offered in those fields listed under Soc. 895, 896. Prereq: Consent of instructor. 3 cr.

899. MASTER'S THESIS

Usually 6 cr., but up to 10 cr. when the problem warrants.

Soil and Water Science (23)

Allan B. Prince, *Chairman*

Before students are admitted to graduate study in Soil and Water Science they must have had an adequate preparation in the biological and physical sciences. A candidate for the Master's degree shall pass an oral or written examination covering his graduate courses and his thesis.

701. METHODS OF SOIL ANALYSIS

Principles and practice of the more important physical and chemical methods of soil analysis, including sampling technique, particle size distribution, moisture retention, rheological properties, particle density, volume weight, cation exchange capacity, mineral element analysis. Opportunity for experience in the application of flame photometry, spectrophotometry, and isotopic tracer techniques to soil analytical problems. Mr. Prince and Mr. Gee. Prereq: Chem. 403-404 and Phys. 401-402 or their equivalent. 1 lec; 2 lab; 3 cr. (Alternate years; not offered in 1967-1968.)

702. PHYSICS AND CHEMISTRY OF SOIL

Physical and chemical properties of soils; their measurement and rela-

tion to structure, water movement, temperature; and liberation absorption, and fixation of elements in soils. Mr. Prince and Mr. Gee. Prereq: Chem. 401-402 or Chem. 403-404 and Phys. 401-402 or their equivalent. 3 lec; 3 cr.

703. SOIL AND WATER ENGINEERING

The hydrologic cycle, hydrograph analysis, estimating volume of run-off surface and subsurface drainage including principles of discharge measurement, design of small watershed dams, erosion control structures, irrigation systems. Mr. Byers. 3 lec; 3 cr.

704. SOIL CLASSIFICATION AND MAPPING

The genesis, morphology, classification, and mapping of soils. Mr. Peterson. Prereq: S. and W. 501 and Geol. 401 or 407 or permission of instructor. 2 lec; 1 lab; 3 cr. (Alternate years; offered in 1967-1968.)

710. GROUND-WATER HYDROLOGY

Basic principles with emphasis on physical properties of water-bearing materials, Darcy's law and the coefficient of permeability, selected steady and non-steady state solutions of the basic flow equation for ground-water motion, well hydraulics, and chemical quality of water. Mr. Hall. Prereq: S. and W. 703 or permission of instructor. 3 lec; 3 cr.

712. HYDROLOGY LABORATORY

Includes work with fluid and electric analog models, flow measurement, seismic and resistivity techniques, chemical determinations, preparation and interpretation of water-level maps, and analysis of well tests. Mr. Hall and Mr. Byers. Prereq: S. and W. 703 and 710 (concurrently). 2 lab; 2 cr.

797-798. SOIL AND WATER SCIENCE SEMINAR

Library work and discussions on special phases of soil and water problems. Staff. Required each semester of seniors and graduate students majoring in soil and water science; elective for other qualified students. 1 cr.

801. ADVANCED SOIL PHYSICS

The physics of unsaturated water flow. Potential and diffusion theory applied to infiltration and drainage in both uniform and nonuniform porous media. Problems of multicomponent flow including water and heat transfer interactions. Permission of instructor. Mr. Gee. 3 cr.

802. ADVANCED SOIL CHEMISTRY

Lectures, discussion, and problem work in laboratory. Physical chemistry of soils and soil colloidal phenomena. Anion and cation exchange mechanism in soils. Theories of swelling. Crystallographic properties of the clay colloids and their relation to cation and anion exchange. The nature of soil acidity. Oxidation-reduction phenomena in soils. Mr. Prince.

Soil and Water Science

Prereq: S. and W. 702 and Chem. 517 or permission of instructor. (At least one semester of physical chemistry recommended.) 3 cr.

803. ADVANCED GROUND-WATER HYDROLOGY

Advanced treatment including velocity potential differential form of Darcy's law, differential equations of ground-water motion, elastic properties of aquifers, leaky aquifer theory, and selected problems in well hydraulics. Mr. Hall. Prereq: S. and W. 710 or permission of instructor. 3 cr.

895-896. RESEARCH TECHNIQUES

Offered in: (a) Soil-Plant Relationships, Mr. Peterson. (b) Physics and Chemistry of Soils, Mr. Prince and Mr. Gee. (c) Chemistry of Water, Mr. Hall. (d) Hydrology, Mr. Hall and Mr. Byers. Elective only after consultation with the instructor in charge. Hours to be arranged. 1-4 cr.

899, (899). THESIS

A thesis study of some phase of Soil and Water Science is required of all candidates for an advanced degree. 6-10 cr.

Spanish and Classics

Charles H. Leighton, *Chairman*

The Department of Spanish and Classics offers courses leading to two degrees in Spanish, the Master of Arts and the Master of Science for Teachers.

To be admitted to graduate study for the M.A. degree in Spanish, a student must have met requirements substantially equal to those set up for an undergraduate major in that language at the University. In addition, all candidates for admission to the graduate program in Spanish must take the general Graduate Record Examination and the Advanced Test in Spanish. To obtain the degree, the student must fulfill a course requirement and submit an acceptable thesis.

To satisfy the course requirement, he must complete at least 24 credits of graduate work selected from the courses listed below (6 credits are granted for the thesis thus completing the total of 30 established by the Graduate School as requisite for the degree.) Of the 24 credits, 18 must be in Spanish and 6 may be selected from the courses in General Language or from courses in a related literature.

To take a course numbered 850-898, a student must register for the corresponding undergraduate course numbered 750-798, pass it with a grade of B or better, do supplementary work assigned by the instructor

and prepare a paper of graduate-quality on a topic assigned by the instructor. No student may register for a graduate course if he has already taken the corresponding undergraduate course here or its equivalent elsewhere.

Before undertaking work on the thesis, the student must pass a comprehensive written examination. The examination will be given four times a year: in January, May, August, and September. The candidate will be permitted to take the examination only twice. If he fails in his first attempt, he must wait at least three months before taking it again.

The thesis must embody the results of independent investigation and be written in a form acceptable to the Department. It must be submitted to the Thesis Director before April 20 of the academic year in which the degree is to be granted.

To be admitted to graduate study for the M.S.T. degree in Spanish, a candidate must have satisfactorily completed the requirements for secondary school teacher certification in the language. To obtain the degree, he must complete 30 semester hours of work at the graduate level. Since it is intended for teachers already in service, courses leading to this degree will normally be chosen from Summer Session offerings. Secondary school teachers interested in this degree should consult the Department Chairman.

Spanish (62)

751. SPANISH LITERATURE UP TO 1600

Readings and discussion of the great human creations of early Spanish Literature, such as *El Poema de Mio Cid*, *El Libro de Buen Amor* and *La Celestina*, and their social and historical background. The course will cover Spanish literature before Cervantes. Conducted in Spanish. Prereq: Sp. 505 or equivalent. 3 cr.

752. DRAMA AND POETRY OF THE SIGLO DE ORO

The social background of the baroque period. Readings of representative plays of Lope de Vega, Tirso de Molina, Calderon, and the poetry of Lope Gongora and Quevedo. Development of the prose of the period. Conducted in Spanish. Prereq: Sp. 506 or equivalent. 3 cr.

754. CERVANTES

This course traces the development of Cervantes' literary art. Reading and discussion of selection from all the major works of Cervantes. Comprehensive study of the Quijote, its originality and significance, its antecedents, its religious, philosophical and sociological aspects, and its artistic structure. Conducted in Spanish. Prereq: Span. 506 or equivalent. 3 cr.

755. LITERATURE OF THE NINETEENTH CENTURY

Preliminary survey of the Eighteenth Century and readings and discus-

Spanish and Classics

sion in the main literary movements of the Nineteenth Century. Selections from Quintana, Espronceda, Zorrilla, Larra, Duque de Rivas, Bécquer, Pérez Galdos, Valera, Pereda, Clarín, and Echegaray. Social and historical background of Spain in relation to Nineteenth Century thought in Europe. Conducted in Spanish. Prereq: Sp. 506 or equivalent. 3 cr.

756. CONTEMPORARY SPANISH LITERATURE

Starting with the generation of 1898, readings and discussion of the works of such writers as Unamuno, Azorín, Baroja, Machado, J. R. Jiménez, Ortega y Gasset, García Lorca, Pérez de Ayala, Benavente, Casona, plus a survey of Spanish literature and thought since 1939. Conducted in Spanish. Prereq: Sp. 506 or equivalent. 3 cr.

765, 766. SPANISH AMERICAN LITERATURE

The main themes of Spanish American literature studied in the works of its most representative authors and against the historical, social and geographical background of the New World. Conducted in Spanish. Prereq: Sp. 506 or equivalent. 3 cr.

795, 796. SPECIAL STUDIES IN SPANISH LANGUAGE AND LITERATURE

Individual guided study in special topics, with training in bibliography, note taking, and organization of material. Examples of topics that may be selected by instructor and student in conference are: (1) 18th, 19th, or 20th century literature in Spain; (2) literature and civilization in Spain in the Golden Age; (3) the literature of individual Latin-American countries. Staff. Conducted in Spanish. Prereq: Permission of Department Chairman. Variable credit.

851. SPANISH LITERATURE UP TO 1600

Prereq: Sp. 505 or equivalent. 3 cr.

852. DRAMA AND POETRY OF THE SIGLO DE ORO

Prereq: Sp. 506 or equivalent. 3 cr.

854. CERVANTES

Prereq: Sp. 506 or equivalent. 3 cr.

855. LITERATURE OF THE NINETEENTH CENTURY

Prereq: Sp. 506 or equivalent. 3 cr.

856. CONTEMPORARY SPANISH LITERATURE

Prereq: Sp. 506 or equivalent. 3 cr.

865, 866. SPANISH AMERICAN LITERATURE

Prereq: Sp. 506 or equivalent. 3 cr.

895, 896. SPECIAL STUDIES IN SPANISH LANGUAGE AND LITERATURE

Prereq: Permission of Department Chairman. 3 cr.

899. MASTER'S THESIS

6 cr.

Technology (79)

Robert N. Faiman, *Dean*

601. STATISTICAL METHODS IN ENGINEERING AND PHYSICAL SCIENCE

Methods of organizing data and statistical techniques for data analysis as applied to problems in engineering and physical science. Elementary probability theory and probability distributions. Correlation and regression analysis. Design of experiments; factorials, fraction factorials, designs for process optimization. Introduction to quality control; construction and analysis control charts for variables and attributes; statistical aspects of tolerance. 3 cr.

780. ENGINEERING ANALYSIS

The basic principles and analytical methods employed in the solution of complex problems in the various branches of engineering. Prereq: Permission of the instructor. 2-3 cr.

Zoology (70)

Paul A. Wright, *Chairman*

To be admitted to graduate study in Zoology, a student must have completed basic undergraduate preparation in some field of the biological sciences, with at least two years' work in Zoology. Suitable training in botany, chemistry, mathematics, and physics is also necessary. Students lacking these requirements may be admitted but will be required to complete certain courses which do not give graduate credit.

Candidates for the Master's degree in Zoology will be required to pass a written examination covering their general preparation in the field and their graduate and undergraduate courses in the biological sciences. With the permission of the Department Chairman and the prospective Supervisor of the Thesis, a student may elect to submit a thesis in partial fulfillment of the requirements of the Master's degree.

Students who apply for advancement to candidacy for the Ph.D. degree must demonstrate to the satisfaction of the Guidance Committee proficiency in reading zoological literature of two foreign languages, usually French and German, and demonstrate to the Doctoral Committee a broad basic knowledge of the field of Zoology and cognate sciences by means of oral and written qualifying examinations. Before being finally accepted as a doctoral student, and preferably during his master's program, each student must demonstrate his research capabilities by submitting either a

Zoology

special problem (Zoology 895, 896, 2-4 cr.), acceptable to the proposed major professor, or a master's thesis (Zoology 899, 6 cr.)

701, (701). PRINCIPLES OF ECOLOGY

The interrelationships of plants and animals with both their living and non-living environments. Energy relationships, limiting factors, community organization, succession, and biogeography. Staff. Prereq: Zool. 412 or equivalent. 3 cr.

704. COMPARATIVE ENDOCRINOLOGY

The various endocrine organs, vertebrate and invertebrate, with particular emphasis on endocrines which relate to physiology of reproduction. Mr. Wright. Prereq: Zool. 508 or equivalent and organic chemistry. 3 cr.

(706). GENETICS

The physical basis of inheritance, expression, and interaction of the hereditary units, linkage, and variation. The application of Mendelian principles to plant and animal breeding. Mr. Hoornbeek. Prereq: Zool. 412 or equivalent. 3 lec; 1 lab; 4 cr.

711. NATURAL HISTORY OF COLD-BLOODED VERTEBRATES

The various classes of poikilothermic vertebrates, their habits, habitats, and life histories, with special reference to those occurring in eastern North America. Mr. Sawyer. Prereq: General Zoology and Zool. 508. 2 rec; 2 labs; 4 cr.

(712). MAMMALOGY

The origin and diversification of mammals, their ecology and economic importance. Laboratories will emphasize techniques of the mammalogist and identification of local forms. Mr. Francq. Prereq: General Zoology and Zool. 508. 2 lec; 1 lab; 3 cr.

(713). ANIMAL BEHAVIOR

Individual and group behavior patterns of animals with the role of anatomy, physiology, and prior experience emphasized. Techniques and the practical application of the study of animal behavior. Mr. Francq. Prereq: One year of Zoology. 3 cr.

715. NATURAL HISTORY OF MARINE INVERTEBRATES

A field and laboratory course aimed at acquainting the student with the inshore marine invertebrate metazoan animals of northern New England. Emphasis will be on identification, classification, habitat preferences, and behavior of these animals. Field work (collections and observation) will constitute a major part of the course and the student must be prepared to assume some travel expense. Mr. Moore. Prereq: General Zoology. 1 lec; 3 labs; 4 cr. (Also offered in Summer Session annually.)

721. PARASITOLOGY

An introductory course on some of the more important parasites causing

disease of man and animals. Living materials will be used as far as possible. Mr. Bullock. Prereq: One year of zoology. 2 lec; 2 lab; 4 cr.

725. GENERAL PHYSIOLOGY

The fundamental physiological properties of excitability, contractility, conductivity, metabolism, growth, and reproduction. Mr. Sasner. Prereq: One year of zoology and organic chemistry. 3 lec; 1 lab; 4 cr.

729. VERTEBRATE EMBRYOLOGY

The fundamental principles of vertebrate development up through establishment of the principal organs and systems, exemplified in the laboratory by study of representative embryonic forms. Prereq: General Zoology. 2 lec; 2 labs; 4 cr.

730. ELEMENTS OF HISTOLOGY

The microscopic anatomy of principal tissues and organs of vertebrates. Mr. Bullock. Prereq: Zool. 508 or equivalent or permission. 2 lec; 2 lab; 4 cr.

736. ADVANCED GENETICS

Genetic recombinations and mutations, gene action in terms of physiological effects at the developmental and adult stages. Mr. Hoornbeek. Prereq: Zool. 706 or equivalent. 3 lec; 3 cr.

738. ADVANCED GENETICS LABORATORY

Problems and projects with small mammals and *Drosophila*, stressing physiological genetics. Student background and interest to determine content. Mr. Hoornbeek. Prereq: Zool. 736 or equivalent, concurrently. 2 lab; 2 cr.

795, 796. SPECIAL PROBLEMS IN ZOOLOGY

Election of one or more sections of this course provides opportunity for advanced study. Work may involve reading, laboratory work, organized seminars, and/or conferences. Prereq: Permission of the Department Chairman and Staff concerned. 1-6 cr. (Limit of 12 credits from the sections of this course.) Section numbers and subject-matter fields are: (1) Bibliographic Methods, (2) Ecology, (3) Endocrinology, (4) Evolution, (5) Embryology, (6) Genetics, (7) Histology, (8) History of Zoology, (9) Invertebrate Zoology, (10) Physiology, (11) Vertebrate Zoology, (12) Zoogeography, (13) Zoological Techniques, (14) Parasitology, (15) Histochemistry, (16) Protozoology, (17) Systematics, (18) Animal Behavior.

801. FRESHWATER ECOLOGY

An introduction to some of the chemical, physical, and biological facets of the special relationships between freshwater organisms and their environment. Laboratories will include limnological techniques and others necessary for analyzing the variations in freshwater habitat. Mr. Sawyer. Prereq: Zool. 701; courses in physics, chemistry, invertebrate and verte-

Zoology

brate zoology, geology, algology, and aquatic entomology are desirable.
2 lec; 2 lab; 4 cr.

(803). MARINE ECOLOGY

The marine environment and its biota, with emphasis on intertidal and estuarine habitats. Laboratory and field work will stress inquiry, and the application of ecological, physiological, behavioral, biometrical, systematic, and chemical techniques to local problems. Field trips may be scheduled for early morning, late afternoon, or weekends. Travel will be at student's expense, and should not exceed \$30 for the course. Mr. Croker. Prereq: Zool. 701 or equivalent. 2 lec; 2 lab; 4 cr.

818. HISTOCHEMISTRY

The principles and techniques for localization of inorganic and organic substances in tissue sections. Prereq: Zool. 730 and a knowledge of microtechnical procedures. 2 lec; 2 lab; 4 cr.

(820), (821). INVERTEBRATE ZOOLOGY

The morphology, phylogeny and natural history of the major invertebrate groups. Mr. Swan and Mr. Moore. Prereq: General Zoology. Zool. 715 desirable. 2 rec; 2 lab; 4 cr.

(822). PROTOZOLOGY

The general biology of Protoza with particular emphasis on morphology, natural history, and economic importance. Prereq: Zool. 721 or 320 or permission. Mr. Borrow. 2 lec; 2 lab; 4 cr. (Offered alternate years; offered in 1967-1968.)

823. THE HOST-PARASITE RELATIONSHIP

Examination of the interactions of host and parasite, using examples from fish, wildlife, and human parasitology. Particular attention will be given to ways in which host ecology influences parasite populations and the interplay of host and parasite in parasite pathology and immunology. Mr. Bullock. Prereq: Previous training in parasitology, histology, and ecology desirable. 2 lec; 1 lab; 3 cr.

(824). ADVANCED PARASITOLOGY

The basic principles of parasitism as exhibited by various groups of Protozoa and helminths. Emphasis on life cycles, ecology, and host-parasite relationships. Mr. Bullock. Prereq: Zool. 721. 2 lec; 2 lab; 4 cr. (Omitted, 1967-1968).

826. COMPARATIVE PHYSIOLOGY

The means whereby animals, chiefly invertebrate, have met the problems of irritability, nutrition, maintenance of a constant internal environment, and reproduction. Mr. Sasner. Prereq: Zool. 725. 3 lec: 1 lab; 4 cr.

830. INVERTEBRATE EMBRYOLOGY

The developmental patterns as exhibited by the major invertebrate groups.

This will be essentially a descriptive study based upon lectures, library, and laboratory work with living material. Prereq: Zool. 820, 821. 2 rec; 2 lab; 4 cr. (Offered in Summer, 1967.)

895, 896. ADVANCED STUDIES IN ZOOLOGY

The sections of this course provide opportunity for advanced work, either on an individual or group seminar basis. They may involve reading, laboratory work, organized seminars, and/or conferences. Prereq: Permission of Department Chairman and Staff concerned. 1-6 cr. Sections of this course are the same as those listed under Zoology 795, 796.

897, 898. ZOOLOGY SEMINAR

Preparation, presentation, and discussion of reports of recent zoological literature. Subject matter fields are the same as those listed under Zoology 795, 796. Not all areas will be available every semester. Required of graduate students in Zoology. Staff. 1 cr.

899. MASTER'S THESIS

Open to students who wish to do independent original research. Prereq: Permission of the Department Chairman and Prospective Supervisor. 6 cr.

999. DOCTORAL RESEARCH

Open to students who have declared their intention of proceeding to candidacy for the Ph.D. degree.

{
Call
378.742
N5345
1967/68

